SCIENTIFIC AMERICAN

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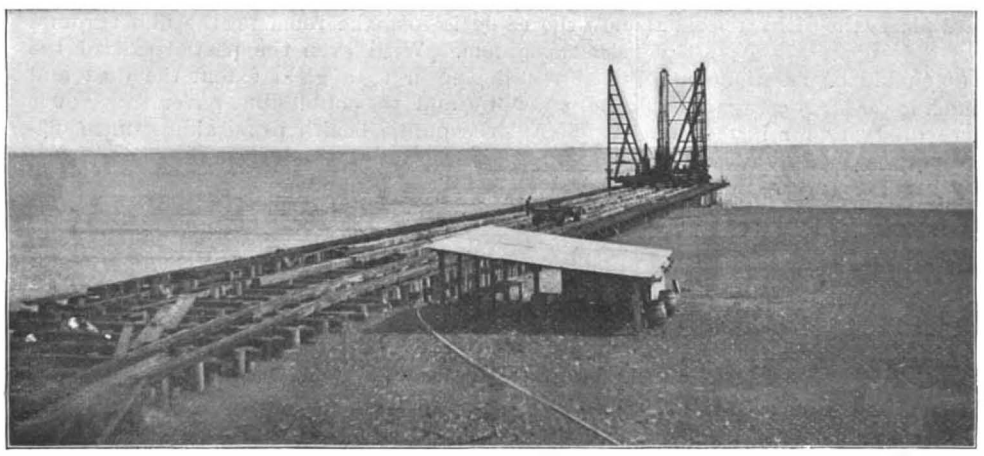
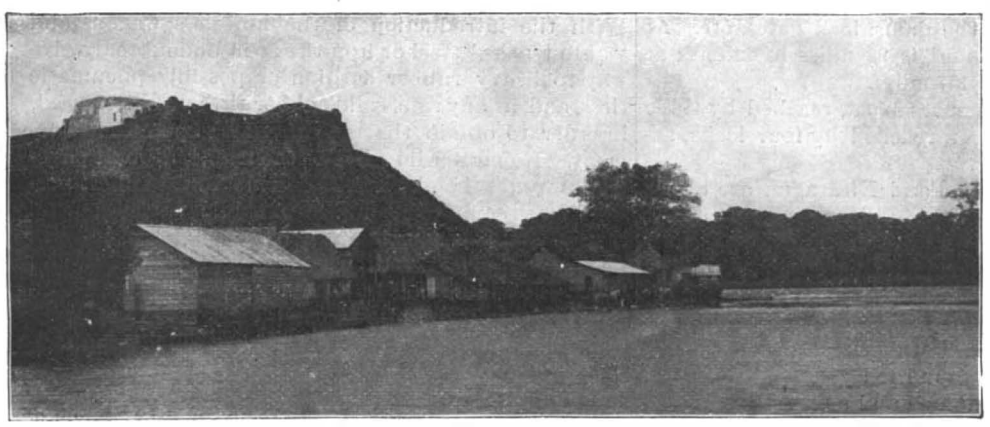
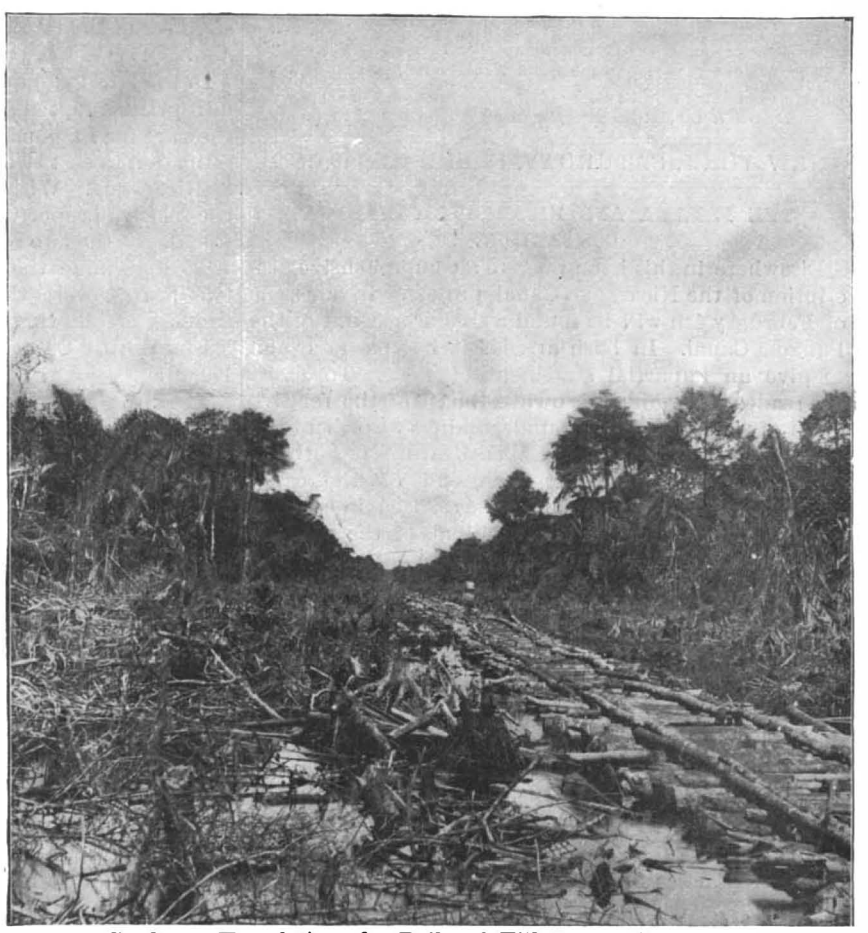


The Jetty at Greytown, Looking Northwest—Shows Accumulation of Drifting Sand Against East Side of Jetty.



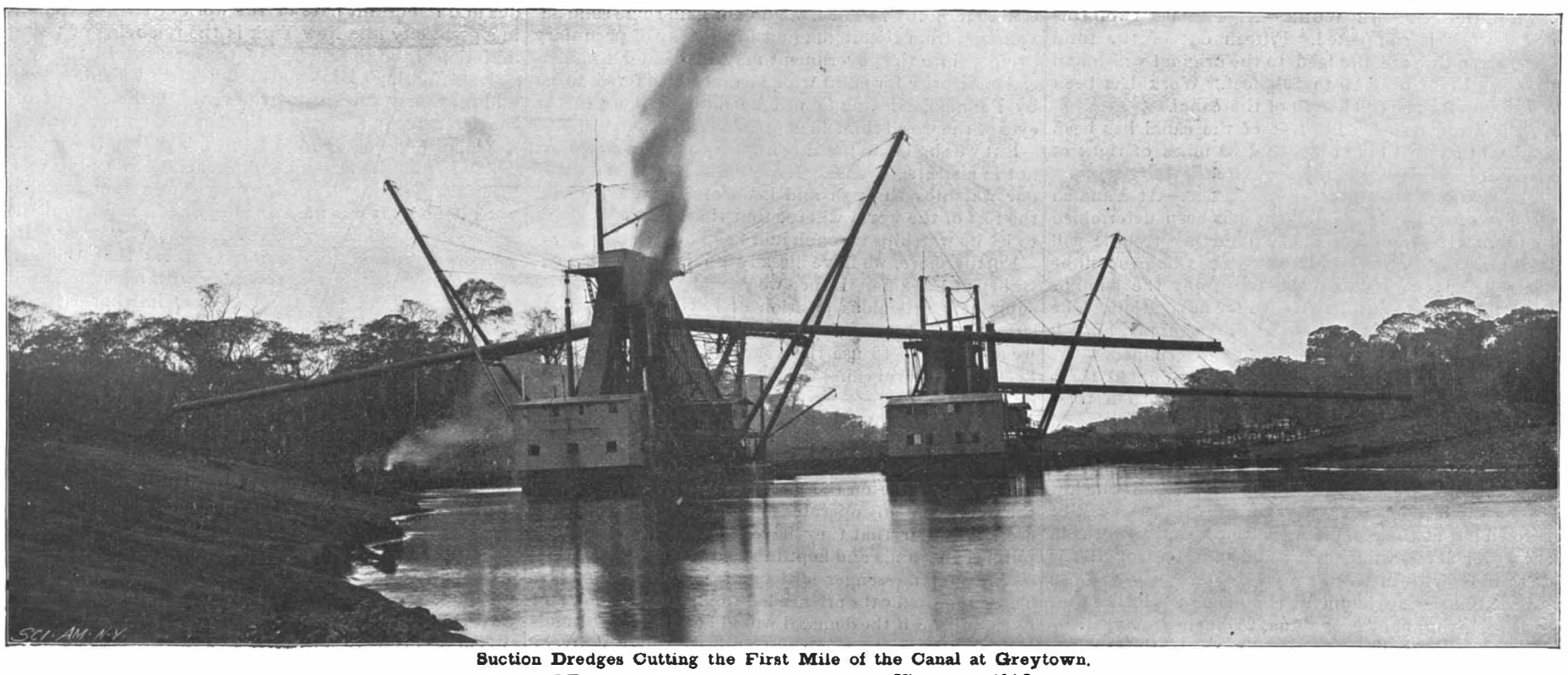
Castillo, Looking up the San Juan—Old Spanish Fort on the Left; Rapids to the Right.



Corduroy Foundations for Railroad Fill Across the Swamp.

The Market in Granada, Nicaragua.

View on the San Juan River at Mouth of the River San Francisco.



Suction Dredges Cutting the First Mile of the Canal at Greytown.

THE PROPOSED NICARAGUA CANAL.—[See page 104.]

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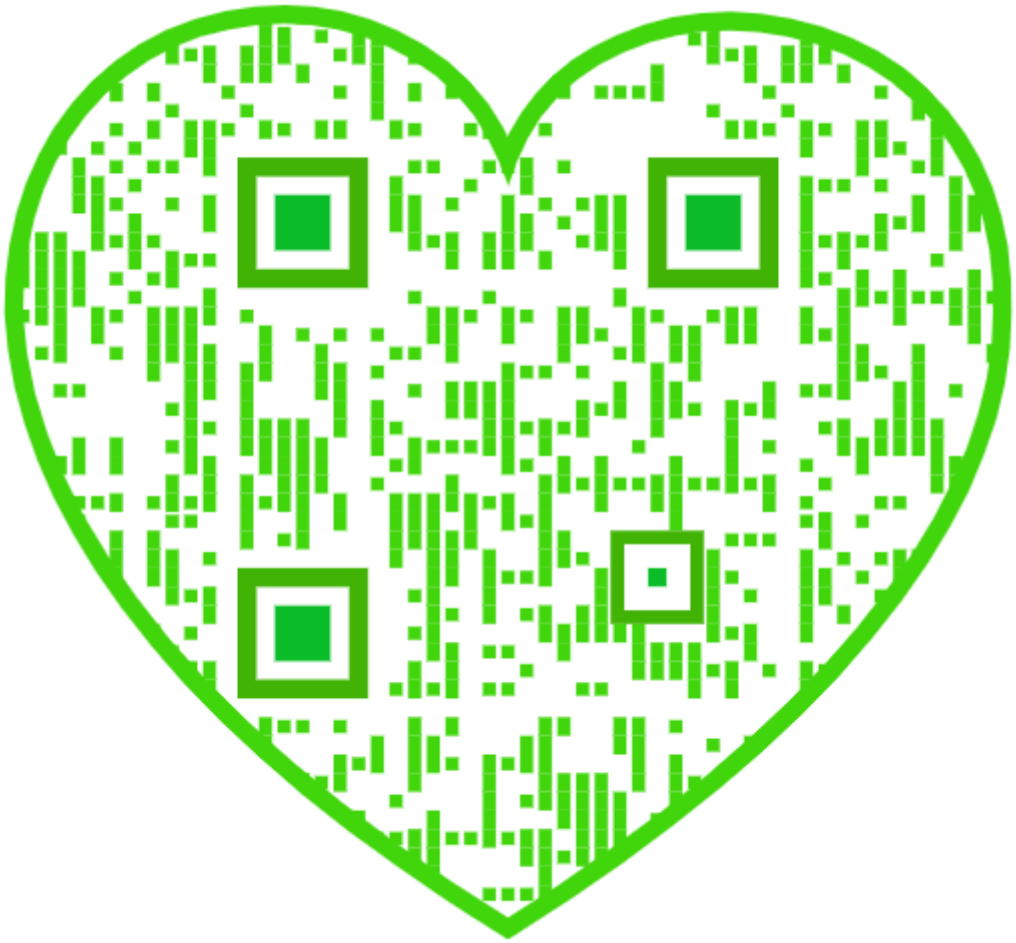

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THE PANAMA AND NICARAGUA CANALS—A COMPARISON.

Elsewhere in this issue we give a comprehensive description of the Nicaragua Canal project. In our issue of February 4th will be found a similar account of the Panama Canal. In both articles it has been our aim to give an impartial statement of facts. To assist the reader in forming his own estimate of the relative merit of these two colossal undertakings we present the following comparison of the salient features of both.

HARBORS.—Panama.—At each end of the canal is a good natural harbor. Both have been in use for about half a century as the terminals of the Panama Railroad. The Bay of Limon is a magnificent landlocked harbor with deep anchorage ; the Panama harbor is shallower, and the maritime canal will have to be kept open by dredging.

Nicaragua.—Artificial harbors will have to be built at each end. At Brito the construction would involve building a 3,500 foot jetty and dredging out a 140 acre harbor to a depth of 30 feet. At Greytown a fine harbor once existed, but has since been destroyed by natural forces. An artificial harbor, protected by jetties, would have to be built in the face of the determined efforts of Nature to prevent it. It would no doubt be practicable to create the harbor ; but it would be at a cost which was estimated at $2,500,000 by the Ludlow board. To this must be added the cost of continuous dredging and of the periodical construction of protective works to prevent the shoaling of the harbor. In 1893, Major McFarland, who was sent by the Secretary of War to investigate the canal, reported to the Senate that the construction of a suitable harbor at Greytown alone would cost $9,500,000, while according to the same authority that at Brito would cost $5,000,000.

TRANSPORTATION FACILITIES.—The Panama Canal has a double track railroad extending parallel with the whole route, and terminating on each ocean at deep water piers.

Nicaragua has 9 miles of single track at its Greytown end. The other 161 miles of the route are destitute of transportation facilities. General Hains, of the Walker Board, considers that a double track standard road parallel to the route of the canal, and costing $100,000 per mile, is an indispensable prerequisite to its economical construction.

PLANT.—Panama has a plant that cost originally $30,000,000 scattered along the route, and has good accommodations provided for 15,000 men.

At Nicaragua there are five dredges, a machine shop and some storehouses at Greytown.

PROGRESS OF THE WORK.—At Panama two-fifths of the work is completed. Fifteen out of the total forty-six miles are dredged to the original width and to a depth of from 16 to 29½ feet. Work has been opened up for the full length of the canal.

At Nicaragua some 4,000 feet of the canal has been dredged to a depth of 17 feet and 30 miles of right of way has been cleared of timber.

DIFFICULT ENGINEERING PROBLEMS.—At Panama the character of the Culebra cut has been determined by tunnels and cuttings and no further trouble will take place as the work proceeds. The Chagres will be controlled by two dams, one to supply the summit level, the other to form a basin for navigation. The amount of flood, possibilities of water supply, and all necessary data have been accurately determined.

At Nicaragua, if the company's route is adopted, there will be nearly 100 dams, big and little, with a total length of 8 miles, most of which will be of earth and clay, upon a clay foundation. If the compromise route is adopted, the number of dams and their height will be reduced, but they will still be numerous. If the low level route be adopted, the earth embankments will be thrown out at the cost of extensive protective works in the lower levels where the canal passes through the delta to Greytown.

RAINFALL.—Maximum at Panama, 93 inches per year. Maximum at Nicaragua, 256 inches per year.

CLIMATE.—At Panama, deadly when the surface ground was first opened up ; but not abnormally unhealthy, now that the subsurface excavation has been reached. At Nicaragua the climate, on account of the prevailing trade winds, is at present healthy. The opening of the work may induce some fever. Save as regards the rainfall of 22 feet per year, it is probably preferable to Panama.

PROBABLE COST OF CONSTRUCTION.—Panama Canal. —Estimated cost, based on four years' survey by 150 engineers, and indorsed by an international commission, including the chief engineers of the Manchester and Kiel Canals, is $102,000,000.

Nicaragua Canal. — Various and widely different schemes proposed, with a variation of 110 per cent between the highest and lowest estimates. The ranking engineer of the latest board places the ultimate cost at about $150,000,000.

In the latest estimates (it should be mentioned) the unit prices adopted are much lower for Nicaragua than they are for Panama, where dredging, for instance, is estimated to cost 50 cents a yard, as against a few cents at Nicaragua. With this disparity in prices, it is likely the relative proportion of 1 to 1½ in a comparison of the cost of the two schemes is approximately correct.

To determine the comparative advantages of the two routes, were they both completed and open to traffic, the following considerations must be noted :

LENGTH OF CANAL.—Panama, 46 miles ; Nicaragua, 170 miles.

TIME OF TRANSIT.—Panama, 15 hours ; Nicaragua, 45 hours.

EXTENT OF DANGER ZONE.—From the time a vessel is lifted above tidewater to the time she reaches tidewater at the last lock she is liable to be wrecked through the failure of the dams, lock gates, etc. At Panama the "danger zone" is 23 miles in extent ; at Nicaragua it extends for 157 miles.

SUMMIT LEVEL.—Panama, 98 feet, reached by three locks ; Nicaragua, 110 feet, reached by four locks, according to latest surveys.

ACCESSIBILITY.—Panama and Nicaragua are about equally accessible for the world at large ; but for a voyage from our Eastern to our Western seaboard Nicaragua is about 375 miles shorter. This is compensated, however, by the 30 hours extra time taken in the transit at Nicaragua as compared with Panama.

STRATEGIC VALUE.—If both canals should be declared neutral (we are committed by treaty to maintain the neutrality of Panama and ought therefore to declare the neutrality of Nicaragua), all warships, including our own, would seek the shorter canal, because of the limited time they would be within the danger zone, as explained above. A charge of dynamite at a dock gate could shut a whole fleet up in the isthmus for an indefinite period.

In summing up our somewhat lengthy consideration of the broad question of a canal across the isthmus we are free to confess that all considerations of a purely practical nature indicate that it is for the best interests of this country and the world at large that only one canal should be built and that it should be secured by the completion of the canal upon which two-fifths of the work has already been done. The problems of construction are simpler, the cost will be 50 per cent lower, and the time and risks of transit less in the case of the Panama route.

The only possible recommendation in favor of the Nicaragua scheme is the sentimental one. It will be "Our own canal, built with our own money, controlled by ourselves." Without dwelling upon the fact that such sentiments are diametrically opposed to the prevailing international conviction that such great waterways should be open to all and at all times absolutely neutral, we ask, Are we ready to spend $150,000,000 for a toy ? For if we do not gain some solid advantages from Nicaragua (not in the way of pecuniary profits, since the government may not enter commercial enterprise for gain) which cannot be offered to us by Panama, Nicaragua will be nothing more in the eyes of the world than an expression of national vanity.

But we shall gain nothing from Nicaragua. Certainly not in a strategic sense. If we build Nicaragua to let our warships through and keep other warships out, the rest of the world will see to it that Panama is built to let its warships through and keep ours out.

Furthermore, we have already guaranteed the neutrality of Panama. Hence we should be placed in the supremely ridiculous position of having spent $150,000,000 to open an exclusive canal for our navy, while we are pledged to use the very ships of that navy to keep open a rival canal for the enemy.

THE HORSELESS CARRIAGE AND PUBLIC HEALTH.

One year ago a company put thirteen horseless electric cabs for hire on the streets of New York. To-day the same company operates one hundred cabs and they are so popular that they have to be taken from the public cab stands and kept in the cab house to fill telephone and messenger orders of regular customers. Three hundred cabs are needed to fill the demand, and it is doubtful if the demand would be supplied. In addition to the cabs there are at least thirty delivery wagons, pleasure vehicles, etc., in Manhattan proper. It is probable that many hundreds will be in use another year, but the number will be limited, as horseless carriages are complicated pieces of machinery and have to be built carefully, and the factories are now crowded to their utmost.

The merit as regards convenience and economy of the new means of transportation is patent to all, but there is another point which should not be overlooked. In a few years, the horseless vehicle will change the aspect of many of our great cities, and the new industry which has had such a struggle for existence will, in time, transform our cities. In ten years New York has witnessed remarkable changes in transportation. It has seen the old horse cars discarded for the cable, and now the cable is to make room for the underground electric system. With even the partial exit of the horse will disappear to a great extent the dust and mud and noise and the cobblestone pavements, and it will benefit the public health to an almost incalculable degree. The first point to be considered is that of street paving. Each year miles and miles of asphalt have been laid in place of the wretched cobblestone and block pavements. Of course, there are certain conditions under which asphalt pavements are not available, as on streets where the trucking is the greatest, for the trucks, which are heavy in themselves, are loaded with tons of goods, and the metallic tires cut into the asphalt. The cost of keeping a pavement in repair under such conditions is something enormous. A good example of this may be seen on a block of Chambers Street, between Broadway and Centre Street, New York ; the ruts in the asphalt pavement are very deep and repairs are constantly being made. With the introduction of the horseless wagons and "auto-trucks," steel or iron tires will undoubtedly give way to heavy rubber cushion or possibly pneumatic tires, and, at any rate, solid rubber tires would be used, in order to obtain the necessary bite upon the pavement. No matter how heavy the traffic, asphalt pavements would then be available and afford the best possible street pavement for automobile vehicles of all kinds. Cobblestones and Belgian block pavement will be renewed as fast as they wear out with asphalt, and the result will be that in time cab riding will be a positive pleasure and a bicycle can go anywhere.

The noise and clatter which makes conversation almost impossible on many streets of New York at the present time will be done away with, for horseless vehicles of all kinds are always noiseless or nearly so. This question of noise has much to do with the general health of the community. Specialists have many times expressed an opinion that the nervous diseases which exist in the city are aggravated, if not caused, in many cases, by noises incident to a great city's traffic. The bells of the new vehicles will of course be somewhat annoying at first.

A point, most important of all, connected with the displacement of the horse is undoubtedly that of the cleanliness of our streets. When we stop to analyze the dust and mud, we find that two-thirds of all of the dirt which we find in the street is caused by the horses themselves, as the dust from other sources and the attrition of the pavement is slight. Therefore, if all of the horses could be done away with, two-thirds of the dirt would disappear in its turn. While this may virtually be regarded as impossible even a great many years hence, at the same time there is no question that the greater use of the horseless carriage, wagon, and truck will produce a marked effect upon our streets. The number in use is so comparatively small at present that it cannot be reckoned with. But by the time we have two thousand horseless vehicles in the streets, we will begin to see a marked difference. The most obvious and important part of the work of street cleaning in a great city like New York is the removing of accumulations from the surface of the streets. In the late Colonel Waring's book, entitled "Street Cleaning," we find that forty per cent of the entire disbursement of the department is for sweeping and sixty per cent of the laboring force is employed in this part of the work, which is now done by hand. Machine sweeping was formerly much used, specially by contractors, but the work done by it was unsatisfactory and the dust raised even after preliminary sprinkling was very great. It is now considered by sanitary experts that there is little, if any, economy of sweeping with machines, and in the summer of 1895 the use of it in what is now known as Manhattan and the Bronx Boroughs of the city of New York was abandoned. At the present time there are 1,600 men engaged in sweeping the streets of New York. The wages of the men vary from $50 to $60 per month, depending on whether they have worked one, two, or three years for the Department. The average amount they receive is, consequently, $55 a month, or $660 per year ; this, multiplied by 1,600, gives us $1,056,000. This is the actual amount spent in sweeping alone, but in addition to this must be considered the cost of brooms and scrapers, and also carting and dumping. The 1,600 men collect 690 loads of sweepings per day, each load containing 1·5 cubic yards, so that each day 1,035 cubic yards of street sweepings are carted away to the dumps. In the New York Street Cleaning Department, 32 per cent of the appropriation goes for carting and 25 per cent of the

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laboring force is employed upon the work of carting, from which it will be seen that the cost is very great. Of course, only a part of the expense of carting should be charged to removal of the street sweepings, for garbage, ashes, paper, and refuse must also be carted away; at the same time, the expense of moving 690 loads to the dumps and afterward carrying the same on scows to sea and dumping amounts to a great deal. The average cost for disposing of the sweepings and refuse in 1896 was 17·9 cents per cubic yard from deck scows, and on the dumping scows the cost was slightly less. The capacity of a modern self-propelled automatic dumping boat like the Delehanty boat "Cinderella" is 500 cubic yards. With the advent of the horseless carriage a considerable portion of the sum spent in sweeping, carting, and dumping dust and mud from the streets would be saved. This is a general proposition, which at the present time cannot be reduced to figures, but it is very safe to say that several hundred thousand dollars per year will be saved on street sweeping if 50 per cent of our vehicles were actuated by motors.

The question of health must be also considered. In summer, the dry dust rises in clouds and attacks the delicate membranes of the nasal passages and throat, producing irritation and coughing. Mud consists, of course, in sweepings which are made into a sirupy mass with the aid of water, and if the dry dust is bad, the mud is infinitely worse. When the streets are practically relieved from so-called "dust," it will be a boon to every housewife. Costly draperies and curtains are damaged each year by the dust from the street, and often windows are closed on this account when they should be opened to properly air and ventilate the house. With the advent of streets which are clean and which can be kept clean with a minimum of expense, it is probable it will tend to greater neatness on the part of the community at large, for it is a true fact that cleanliness breeds cleanliness.

FIBER PLANTS FROM OUR NEW POSSESSIONS.

Commercially there are thirty or forty species of fiber plants found throughout the world, but botanically there are over one thousand species the fiber of which can be made more or less useful in the arts and industries. Each country has its special fiber plants, which it tries hard to use as successfully as those imported from other lands, and there are plenty of instances where governments and private individuals have spent fortunes in trying to bolster up artificially an agricultural industry of fiber production that should never have been encouraged. The rage for finding new fibrous plants in this country that would supplant in the industrial world those that have been used since the world began has had its day, and the more sensible view is now being accepted of obtaining the fiber from the country where it can best be raised. A good many of the best fiber plants have been introduced in this country, and their culture is being pursued with more or less success; but, after all, our manufacturers depend mainly upon other countries for their supply of raw material.

In view of the territorial changes produced by the war, the fiber industry is of peculiar interest to the farming and manufacturing world. The islands affected by the war are all noted for the fiber plants raised on them; and taken together—that is, Porto Rico, Cuba, and the Philippines—they produce a large bulk of the best plants, except cotton, used in a commercial and manufacturing way for their fiber. Manila hemp has long been familiar wherever civilization exists; sisal hemp comes from Cuba, in times of peace, as largely as from Yucatan or the Bahamas; Cuba bast is essential to the millinery trade of the world; and Sunn hemp and cebu hemp are but trade varieties that come from the same islands.

The Philippines, in particular, are rich in fiber plants, with possibilities for development and expansion scarcely conceivable. Throughout the archipelago, it is estimated, all the fiber used in the manufacturing world could be produced at a cost that would annihilate similar industries anywhere else in the East. This is not entirely true, however, for neither cotton nor flax could ever find a foothold in the Philippines to compete with the United States. Our cotton is already seeking Eastern markets in ever increasing proportions, and great prospects are anticipated for this trade. But in turn we must secure our hemp and jute, and other fiber material, from the lands where they best grow.

There are over thirty species of fiber plants that can be raised in this country, but most of them are unimportant in the commercial world, and most of the others thrive only very indifferently in the United States. Should we, however, extend our colonial possessions so that in time they included Cuba and the Philippine Islands, as well as Porto Rico, we would be the greatest fiber producing country on the globe. We would hold the key to the world's supply of raw material for textile manufacturing, as well as for many other products. Under the intelligent and judicious management of American capital and brains, these fiber products could easily be doubled in quantity and value. The world would soon be richer in raw material for one of the largest branches of the manufacturing industry.

At present the leading vegetable fiber that is imported into the United States, according to statistics of 1897, is sisal grass. Most of this sisal grass comes to us from Cuba, Yucatan, and the Bahamas. Attempts have been made to introduce its culture in Florida, and with some success; but its superior growth in its native islands, and their close proximity to the United States, will forever preclude it from becoming an important industry here.

Next to sisal grass comes Manila hemp in commercial importance. The imports of this amount to nearly $4,000,000 annually. This hemp has also been experimented with in this country, and in other lands, but the world's trade will always look for its main supply to the islands of the East, where it flourishes as naturally as cotton does in our Southern States. It can be produced and shipped to this country cheaper than our farmers can raise it at home. Cebu hemp comes from the Philippine Islands also, and is merely a trade variety that has its useful purpose in the manufactures.

Jute and "jute butts" stand third on the list of imported fiber plants. Jute comes from a variety of countries. Originally India controlled the trade in jute, but the West Indies and Cuba have entered the market in competition with her, and they are lusty rivals that cannot be ignored. The possibilities of Cuba in this line are only partly appreciated, for rebellions and wars have so long agitated the island that little experiment has been made in anything outside of sugar and tobacco growing. An appreciative era now dawning upon the island may prove many things only dreamed vaguely of heretofore. The value of "jute butts" imported into this country runs considerably over a million dollars. In all between nineteen and twenty million dollars' worth of vegetable fibers are imported into the United States each year in the raw condition. Manufactured into articles of use, several times as many millions would hardly represent the full value. Flax manufactures alone represent some years $12,000,000 in imports, and other fibrous goods mount well up into the millions.

Since 1890 the Department of Agriculture has been engaged in making experiments with fiber plants in various parts of this country, and farmers have been encouraged to grow certain fiber plants for manufacturing purposes. Nearly all of the commercial fiber plants have been tested by the Department experts, and some of them have been recommended for general culture. This movement, started seven or eight years ago, has not exactly proved all that the inaugurators of it anticipated. Ramie has been raised to some extent in Florida; sisal hemp from Yucatan has been established in a limited way in parts of the same State, and a little impetus has been given to the rejuvenation of flax culture—one of the oldest agricultural products in this country. Great efforts have also been made to utilize some of the plants that grow naturally here for fiber manufacturing. Thus the palmetto fiber and vegetable hair of the Spanish moss growing on the trees of the Southern States have found some use that makes the product of fair value. Several of the leading varieties of palms in Florida have been cultivated for the fiber in their stalks and leaves, and the palmettoes have been utilized for making brushes and brooms. Jute culture has been extended so that we produce annually a fair crop. Yet this weed is natural to this country, and some varieties are the finest and best grown in the world.

It is possible to double the annual production of fiber plants in the United States, and thus increase the manufactures; but the history of many of our agricultural products hardly warrants one in predicting that we can raise successfully most of the fiber plants needed in this land. The flax industry was at one time an important industry in New England; but it has steadily declined for half a century now, because farmers could put their land to more profitable use in raising other crops. No amount of push and energy has ever been able to renew this industry, although spasmodic efforts have frequently been attempted. There was plenty of land in the world where flax throve better than in the United States, and it could be cultivated cheaper there than in this country.

Likewise the hemp industry in the South has been declining ever since 1870. It flourished and expanded in the early sixties, and just prior to the rebellion it was an important industry, promising in time to rank second only to cotton. But sisal and manila hemp appeared in the market, and the Southern hemp could not compete with them. Our hemp lost its position in the manufacturing world, and sisal and manila were soon used in its place. No amount of study and experiment could rejuvenate the decadent industry.

While there are undoubtedly many native fiber plants growing in this country that will be found useful in many industries, it will be impossible to make them compete with the low-priced fibers that come from many of the tropical and semi-tropical islands. Nor shall we ever be able to introduce these foreign plants into this country so that their culture will prove successful enough to supply us with the raw material for all of our manufactures. The world will still look to the Philippines, the West Indies, Cuba, Central America, and China and India for the fiber plants that supply material for cheap clothing, bagging, rope, and similar products.

In the islands that have been acquired from Spain, however, we have the soil and climate to produce all the fiber plants that are lacking in this country. Their resources in this respect are so great that they could soon supply the world with all the raw material used for cheap textile goods, cordage, nets, and kindred necessities. In Porto Rico alone we could raise successfully a dozen of the leading fiber plants, while in Cuba and the Philippines there are many peculiar only to those islands. In the future development of these countries, if under American tutelage, the fiber industry will easily be one of the leading industries.

G. E. WALSH.

TESTING OF CHILDREN'S STRENGTH.

A scientific investigation of the physical strength of the Chicago school children is to be undertaken by the Board of Education of that city, and the results which they obtain will be used as a standard for the treatment of pupils as to their capacity for mental endurance and physical exercise. It is thought that the results would be very important and serve to revolutionize the methods which are now in vogue. The theory of the test is to determine what is known as the "fatigue period" of a child, or that period of its life at which its energies are at the lowest ebb and, therefore, the time when its school work should not be pressed. The scheme will be put in operation at one of the largest elementary schools, in which at least one thousand children are taught. The pupils will be weighed and measured and will be examined, for the purpose of determining their physical condition. A test will then be made of the strength and endurance powers of the muscles of the child. This will be done by the special psychological instrument called the "ergograph," adapted for the purpose.

PULLMAN.

The dream of the late George M. Pullman of establishing a model industrial town will soon become a thing of the past, as the model town of Pullman, Ill., will soon lose its peculiar identity and will become a free community, and the anomaly of a city within a city is now at an end. The Pullman Palace Car Company has accepted the decision of the Supreme Court of Illinois, sustaining the contention of the Attorney-General, and the terms of the decree are now being prepared. This decree will divorce the great corporation from everything save the business of building cars. The churches, schools, hotels, arcade, market house, public library, and some 2,000 brick residences will have to be sold to the highest bidder, and the brick works will pass from the control of the company and the streets themselves will now be controlled by the authorities of the city of Chicago. Preference will be given to employes in purchasing the homes which they now occupy.

GREAT ACTIVITY IN THE STEEL TRADE.

The steel mills of the United States are now doing an enormous business. The Illinois Steel Company has sold its entire output of steel rails for the year. This amounts to not less than 650,000 tons. A maker of agricultural implements recently purchased 10,000 tons of bar iron in one week, and all branches of the iron and steel trade seem to feel the general prosperity of the country.

GREAT STEEL AND WIRE COMBINATION.

It is announced by the officials of the American Steel and Wire Company that the principal steel and wire interests of the United States are to be consolidated into a new corporation to be known as the American Steel Wire Company. The new company will be capitalized for $90,000,000. The consolidation will include a large number of the principal wire manufacturers of the United States.

WHEN a train is rounding a curve, the ordinary locomotive headlight points off into the surrounding country, and is useless. A mechanical engineer of a Western railway devised an attachment by means of which the light is maintained in line with the track. The light is mounted on a turnable which is rotated through the proper angle by a cable passing around pulleys and leading to the two piston rods of a small double-acting air cylinder. The motion of the piston is regulated by a valve in the cab, the air pressure being taken from the air brake system. The headlight turns on inclines so arranged that when the headlight travels up the incline it will have bearings on the two quarters on which it travels. The object of this is to return the headlight to its normal position automatically when the air is released. The device has been practically tested.

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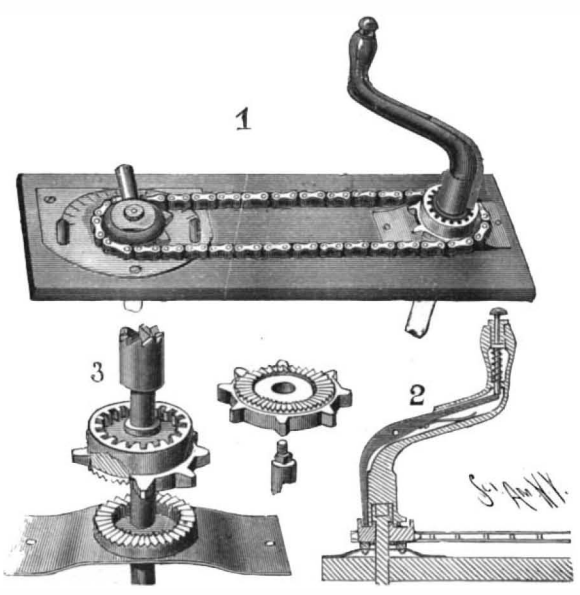
AN INGENIOUS BRAKE AND MOTOR-CONTROLLER FOR ELECTRIC CARS.

The brake-controlling and switch mechanisms of electric cars are usually operated independently, and require the use of both hands. In an invention patented by Adolphe Grossman, of 205 South Peters Street, New Orleans, La., a mechanism is provided whereby the motorman is enabled to control both the motor and brakes with one hand only.

Fig. 1 is a perspective view of the mechanism. Fig. 2 is a longitudinal section of the brake-crank. Fig. 3 is a perspective view, partly broken away, of the brake staff, the portions being shown separated. Fig. 4 comprises perspective views of portions of the upper end of the rheostat shaft.

The two parts of the apparatus, the brake and



GROSSMAN'S BRAKE AND MOTOR-CONTROLLER FOR ELECTRIC CARS.

switch controlling mechanisms, are mounted upon a shelf, secured to the dashboard of a car.

The brake mechanism comprises a shaft and crank, which may be connected at will. The upper end of the brake-staff is provided with beveled teeth (Fig. 3), designed to be engaged by the interior teeth of the crank, the arrangement being such that the staff can be operated in the usual manner. To the brake-staff a sprocket-wheel is secured, provided at its under side with a clutch face engaging a corresponding face mounted on a spring plate (Fig. 3). The sprocket-wheel has an interiorly toothed flange adapted to be engaged by a detent lever fulcrumed on the crank (Fig. 2) and held out of engagement with the flange by a spring. In order to enable the motorman to place the detent lever in engagement with the flange and thereby to lock the sprocket-wheel to the crank, a pusher-pin is provided, normally held in the position shown in Fig. 2 by means of a coiled spring. When the pusher-pin is depressed, the detent lever will be placed in engagement with the toothed flange; when the pin is released, the lever is disengaged by its own spring.

Loosely mounted on the rheostat-shaft, is a sprocket-wheel connected by means of a chain with the brake-staff sprocket-wheel. The rheostat sprocket-wheel has a clutch face (Fig. 4) designed to engage a similar face on the under side of a plate fixed to the shaft. The plate has an arm by means of which the current is turned on and off (Fig. 1).

When the motorman desires to stop his car, he depresses the pusher-pin, in order to lock the brake-staff sprocket to the crank, and turns the crank to the right. By reason of the chain connection with the rheostat sprocket, the motorman, in turning the brake-staff, also causes the switch arm to rotate and shut off the current. When the current is cut off, the motorman releases the pusher-pin in order to disengage the sprocket-wheel from the brake-crank, and continues to turn the crank until the car is stopped. By turning the crank to the left, the brakes are released; by depressing the pusher pin, the two sprocket wheels will operate to cause the switch arm to turn on the current in order to start the car.

Should the motorman forget to release the plunger when the switch arm has turned the current on or off, the continued rotation of the crank can do no harm, because the clutch teeth of the rheostat sprocket will ride over those of the switch arm plate.

Another Form of Wireless Telegraphy.

Prof. K. Zickler, according to Ackermann's Gewerbe Zeitung, has devised a new method of telegraphing without wires. Prof. Zickler calls his invention "light-electric telegraphy," because he uses the invisible rays of the ultra-violet spectrum, which have the property of inducing the discharge of electric sparks at a receiving station. These rays are produced at the transmitting station by means of a powerful arc light, and are directed by means of a reflector toward the receiving station. The further property of these rays, of being absorbed by glass, presents a means whereby signals can be so transmitted that the pencils of visible rays emerging from the reflector are not affected in intensity. In front of the reflector a glass closure consisting of a movable glass slide is mounted. The effective invisible rays can be transmitted only by opening the glass slide. The rapidity with which the glass slide is opened and closed will produce synchronous spark-signals at the receiving station, which signals may be made to correspond with the dots and lines of the Morse alphabet. Prof. Zickler, says our contemporary, has experimented with his apparatus at distances of one and one-half kilometers.

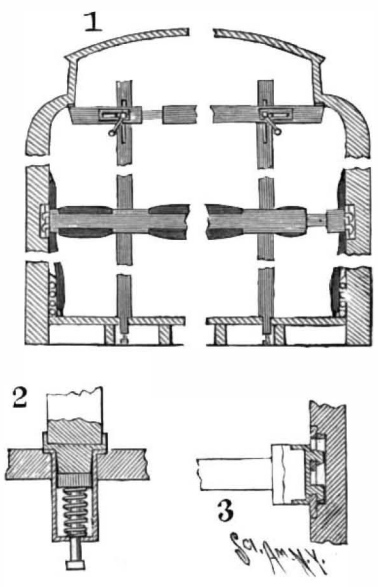
A PORTABLE HORSE STALL FOR RAILWAY CARS.

In order to facilitate the transportation of horses, the New York, New Haven and Hartford Railroad has fitted up several baggage cars with a novel portable horse stall, the invention of the general foreman of the road shops, Mr. John P. Young, of New Haven, Conn.

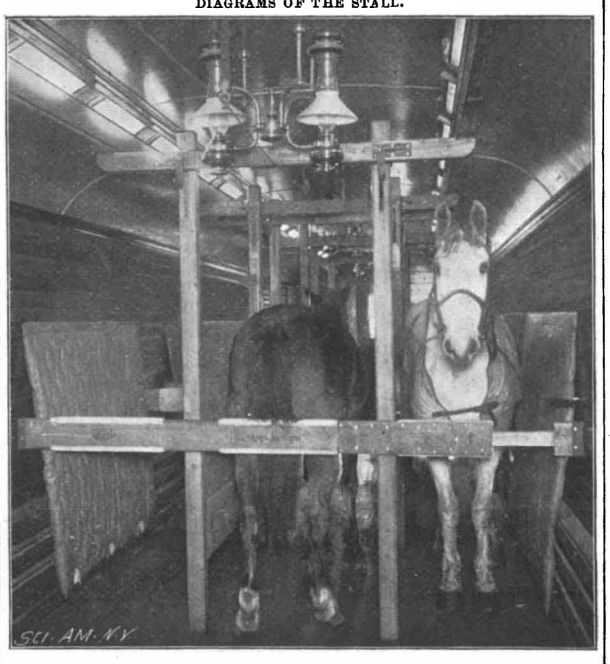
Of our diagrams, Fig. 1 is a vertical, transverse section through a car having the fixtures applied; Fig. 2 is a partial side elevation and section of one of the stanchions and of a socket adapted to receive the stanchion; and Fig. 3 is a sectional view of one end of a cross bar locked in place in a wall socket.

The stall fixture consists essentially of upper cross bars, intermediate cross bars, vertical stanchions, and partitions. The upper cross bars are formed of sections and are arranged for locking connection with the deck sills of the car. The stanchions have their lower ends fitting in sockets in the floor and their upper ends adjustably secured to the upper cross bars. The floor sockets, as shown in Fig. 2, are provided with spring-pressed blocks, upon which the stanchions rest. When the stanchions are removed, the blocks are forced up flush with the floor and thus prevent the entrance of dirt to the sockets. The stanchions are, furthermore, formed with vertical slideways, in which partition boards are held. The intermediate cross bars are formed of sections, and, as shown in Fig. 3, are locked in keyhole sockets in the side walls by means of studs carried on the ends of the bars. These intermediate cross bars intersect the stanchions and serve to hold the upper cross bars in locked position. On the intermediate cross bars, the partitions, and the side walls, pads are secured.

By means of these fixtures, a sixty-foot baggage or express car can be quickly divided into sixteen stalls. The width of the car can be made to accommodate two, three, or four horses. The horse stall possesses the merits of being quickly set in place, of being readily disconnected, and of being adjustable to cars of any size.



DIAGRAMS OF THE STALL.



THE HORSE STALL SET UP IN A BAGGAGE CAR.

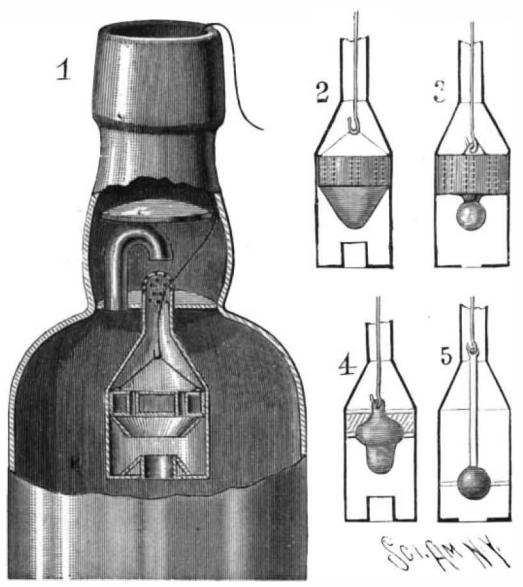
YOUNG'S PORTABLE HORSE STALL FOR RAILWAY BAGGAGE CARS.

A NEW NON-REFILLABLE BOTTLE.

A novel bottle-closure has been invented by Atmaran Abaji Bhise, Ramwadi Market Post, Bombay, India, which closure is primarily intended to prevent the refilling of bottles or the adulteration of liquids contained in the bottles.

Fig. 1 illustrates one form of the invention, and Figs. 2 to 5 represent modified forms of a closure used in the bottle.

At the junction of the neck with the bottle-body a sealing disk, perforated at two points, is held in place. Through one of the perforations a straight glass tube



BHISE'S NON-REFILLABLE BOTTLE.

is inserted, which at its upper end is formed with a screen projecting above the disk, and which at its lower end is enlarged into a chamber. At the bottom of the chamber a valve-seat in the form of a truncated cone is produced, which seat surrounds an opening. Within the chamber a valve, cylindrical in its upper portion and conical in its lower portion, is held to slide, so that it can be seated upon the valve seat. The cylindrical portion is vertically bored to provide passages for the liquid and for air when the valve is raised. To a bail on the valve-body, a wire is hooked, which passes up and out of the bottle. In the remaining aperture of the sealing-disk, the long leg of a bent tube is inserted, the short depending leg being placed above the screen end of the straight tube. On top of the bent tube a circular baffle-plate is secured of such diameter as to leave a circular crevice between the edge of the plate and the neck.

When the parts of the closure are in the positions indicated in Fig. 1, the bottle may be filled. The liquid, after passing the baffle-plate, will enter the bottle-body by way of the screen-head of the straight tube. While the bottle is being filled, air will escape from the bent tube. In sealing the bottle the wire strand is pulled with sufficient force to straighten the hook and to enable the strand to be withdrawn. The bottle is then corked in the usual manner.

When the bottle is to be emptied, the liquid may be readily poured out, for air may enter through the short tube when the valve is unseated by the tilting of the bottle. If it be attempted to refill the bottle, the valve will gravitate to its seat and effectually close the opening to the bottle-body. Since in this position the valve prevents the escape of air from the bottle, it will be impossible to fill the bottle by means of the short bent tube, since the liquid must rise in the bent portion.

In Figs. 2, 3, 4 and 5 the valve-body and seat are somewhat changed in formation, but the function and operation of these valves are the same as that already described.

THE French Minister of Public Works, in view of some recent serious railroad accidents, now requires all railway trains which carry passengers to be provided with requisites for prompt surgical aid to the wounded, as even when the services of surgeons are promptly obtained they are not always provided with the necessary bandages and other surgical appliances to aid the injured. The Lehigh Valley Railroad has for years carried "first aid packets" on all trains. The amount of suffering which such precautions have relieved and the number of lives which have been saved is very great. All railroad companies should, in their own interest, carry such outfits, and if they do not choose to do this at their own volition, they should be compelled to by proper legislation.

HARVARD University has decided to spend $175,000 of the Henry L. Pierce bequest in the erection of a new building. Two-thirds of the building will be devoted to the courses offered by the Department of Engineering in the Lawrence Scientific School.

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Monazite Production in North Carolina.

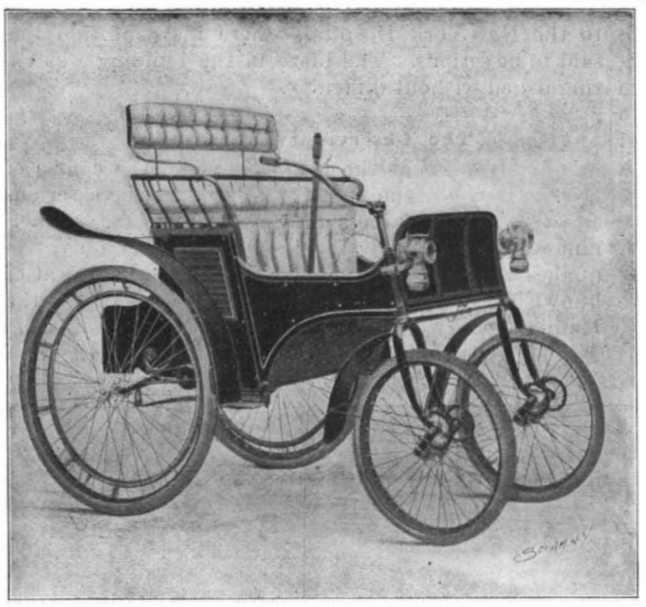
This industry is limited in extent by the lower prices and greater quantities of monazite found in Brazil. After several years of absolute quiet, with neither mining nor shipping, in Cleveland County, North Carolina, in 1897 a spasmodic effort was made to revive the business, says The Engineering and Mining Journal. Several carloads of monazite which had been mined during the period of activity several years ago remained on hand, scattered among a large number of holders. These were bought up early in 1897 and several carload shipments were made. Owing to the length of time this sand had remained on hand, and a total lack of any buyers at any price, it was possible to purchase these mixed lots at a low price. Even with this advantage it was found impossible to meet Brazilian competition; much less can this be done where it is necessary to mine the mineral. Nearly all the mines or streams have been worked over once, and any new work must be at a disadvantage, labor being less skilled, while all the old tools have been lost or worn out. The operations in any case being so small, a price direct from the mines cannot be made which will meet competition. The present inquiry for monazite sand is brisk enough, but the conditions imposed are practically prohibitory.

The first is a guarantee of thoria contents. The nature of monazite mining is such that only comparatively small quantities can be obtained from one locality—at the outside ten tons, and this only after considerable time. Buyers want at least car lots and regular, quick shipments, besides demanding guarantee of thoria. Here is the stumbling block. No producer will guarantee thoria without an analysis, and the sand, having been produced from a dozen properties, may vary from 1·5 per cent thoria to even 6·5 per cent. Each mine will vary as to thoria contents. Hence, to be at all certain of the quantity of thoria, only well known mines which produce a sand high in tenor can be worked at all. About 5 per cent thoria is an acceptable percentage and will always command attention; but it would be far safer to guarantee 4 per cent or less. These lower grades are not wanted at any price. Only an analysis can correctly determine the thoria contents. Some bright yellow 90 per cent monazite sands may be far lower in thoria than seemingly inferior sands.

Few of the actual miners have any capital, and they would not be willing to carry on hand more than 500 pounds of monazite sand. Hence the business should be handled by an intelligent man with money to take up and pay cash for sands to the amount of a shipment, say $1,500. He would be called upon to give a guarantee.

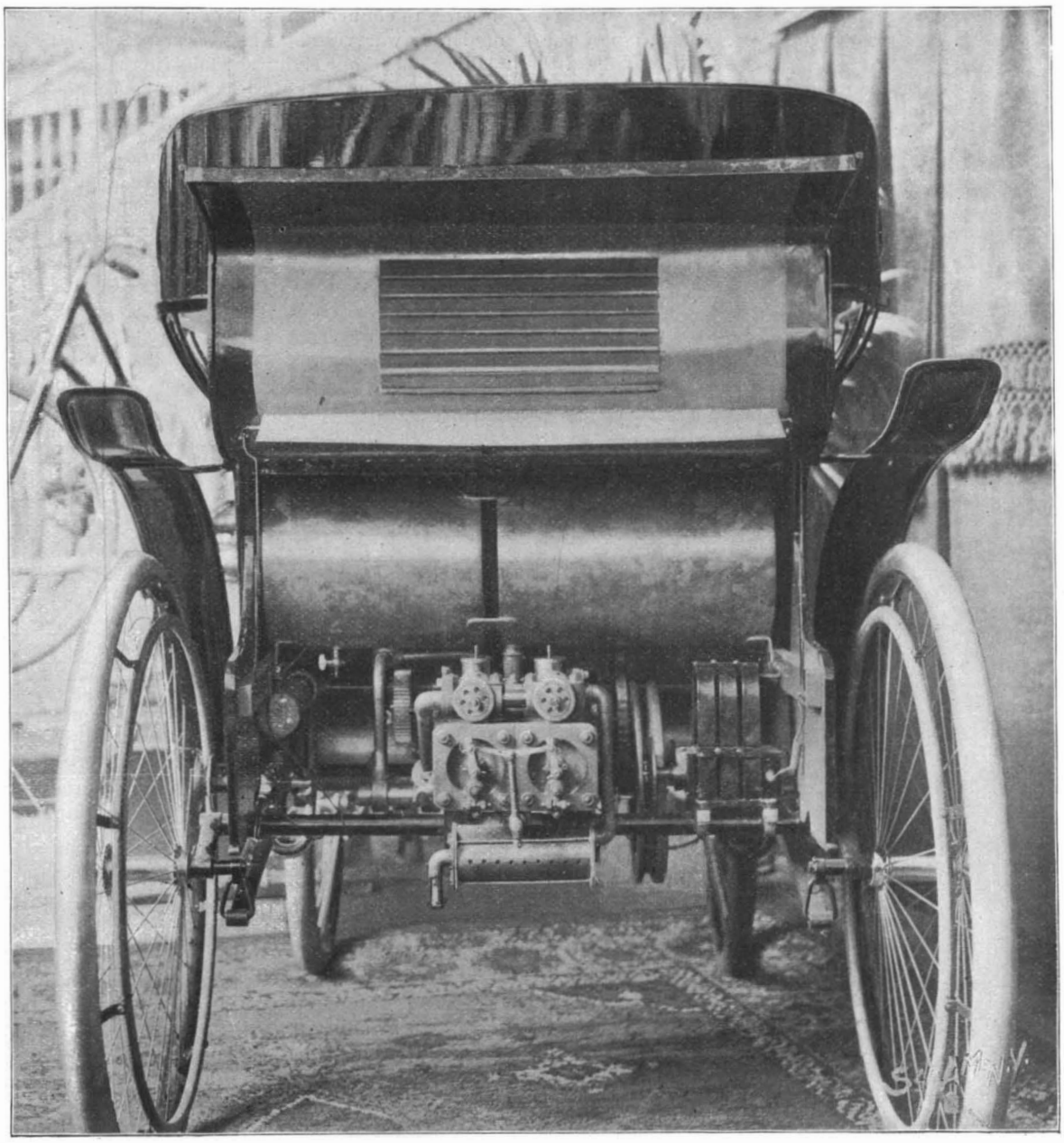
Unfortunately, there is not profit enough in the business to induce any one with capital to take it up. The monazite industry at one time employed several hundred people and brought much money into the district in Western North Carolina where the sand was found; and its loss is much regretted.

LIEUT. T. C. DICKSON, United States army, of the Springfield Arsenal, has invented a sight which has been accepted by the Ordnance Department. This sight has a wind gage and is so constructed that the drift is automatically made for all ranges up to 1,200 yards, no matter in what direction the wind is blowing. As fast as the sights can be manufactured they will be supplied to the troops to replace those now in use. The official designation of these sights will be "Model of 1898."



THE HERTEL GASOLINE MOTOR PHAETON.

THE TINKHAM GASOLINE MOTOR TRICYCLE.



THE HERTEL MOTOR PHAETON DRIVING MECHANISM.

AUTOMOBILES AT THE LATE CYCLE EXHIBITION.

Great interest was shown by the public in the progress made during the past year in the construction of automobiles at this exhibition, and these exhibits attracted crowds of visitors.

The motive power of the horseless vehicles was about equally divided between electricity and gasoline, each having distinct advantages of its own.

Our accompanying illustrations show types of most of the vehicles on exhibition.

Every one was attracted by the neat looking one-seated gasoline four-wheeled phaeton adapted to carry two persons, called the "Hertel," manufactured at Greenfield, Mass. Its general appearance will be noted in the small illustration. The forward wheels are of bicycle construction, having spring forks, to allow for unevenness of the road, and are connected together by a rod to the horizontal steering lever just in front of the operator.

The interior mechanism will be seen in the large illustration, showing its accessibility for examination by the entire hinged metal back of the carriage being raised. There are two cylinder heads located horizontally in the center, having attached suitable sparking devices, cams, and levers in plain sight. Directly under the cylinders is the muffler for the exhaust, having a small elbow turned downward at one end. It deadens the sound of the exhaust most effectively. To the right of the cylinder is the small dynamo for sparking, the armature of which is rotated by frictional contact with the main shaft fly-wheel; located on the extreme left is the spark coil, and under the seat is a storage battery. The current for sparking is taken from the storage battery, the latter being kept charged by the dynamo when the carriage is in motion. Above the engine cylinders and under the seat are two tanks separated by a small space; the left is for the storage of gasoline, the right for water. It will be seen that the rear axle is of peculiar construction, in the shape of the letter U, and that the single springs supporting the body at the rear are suspended from stirrups depending from the wheel axles. Also the driving wheels have an interior annular driving rim against which the grooved driving pulleys of the main driving shaft impinge and impart the power of the engine to the wheels by friction. This shaft is manipulated forward or backward by the single lever rising upward in the center of the carriage and is one of the features which make the vehicle distinctive. By means of a latch lever attached to the driving lever the operator starts the engine from his seat by engaging the latch lever in a ratchet wheel under the seat attached or geared with the main shaft, so arranged that when the driving lever is drawn suddenly back it will cause the ratchet wheel to rotate the engine enough to allow the sparking, and thus cause the needed explosions. After it is started the latch lever is released and the driving lever pushed forward, which brings the driving grooved pulleys into contact with the driving wheel rims. The speed may be regulated by this frictional contact or by rotating the top of the handle of the driving lever with the hand, which admits or cuts off the air supply to the engine. A backward motion of the driving lever applies the brake. With this one lever several things are accomplished easily and quickly. It is stated that on a fairly level road this vehicle will travel 75 miles on one gallon of gasoline and at any desired speed up to 20 miles an hour. Its weight is 500 pounds.

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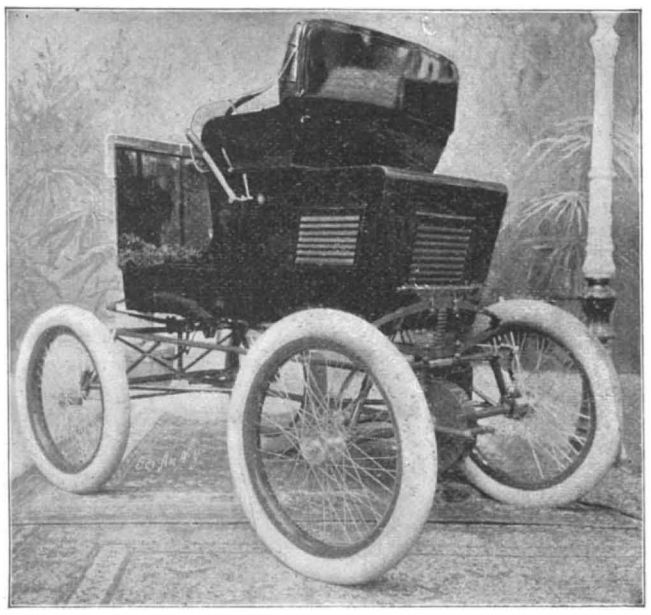
The Tinkham motor tricycle designed for one person was another novelty in the gasoline type. It is provided with a small, double cycle motor, having the usual mixing chamber. The water for cooling the cylinder is in a tank the width of the machine, located over the motor between the two rear wheels, forming a cover for it. The balance wheel may be seen under the left end of the water reservoir. A hand lever on the left throws in or out a clutch which connects the driving shaft to a pedal crank conveniently operated by the feet like a bicycle. To start the machine, the driving shaft, when clutched to the pedal crank clutch, is rotated by the movement of the feet, the clutch is then disconnected by the hand lever and the feet raised and supported on two rests. The speed is regulated by pressure on a small lever attached to the steering handle bar, which cuts off the supply of air to the mixture. The electric sparking is produced by a small storage battery, which is kept charged by a small dynamo geared to the shaft. A muffler is provided at the rear to soften the sound of the exhaust. Power from the engine is imparted to the wheel by a pinion on the engine shaft engaging in an annular geared rack secured on the inside of the rear wheel. A reservoir for gasoline is located in front of the rear axle. The cup-shaped cylinder projecting at the rear is one of the driving cylinders, the other projecting forward in the same way on the other side. It is said to have a speed of 15 miles an hour and is easily managed.

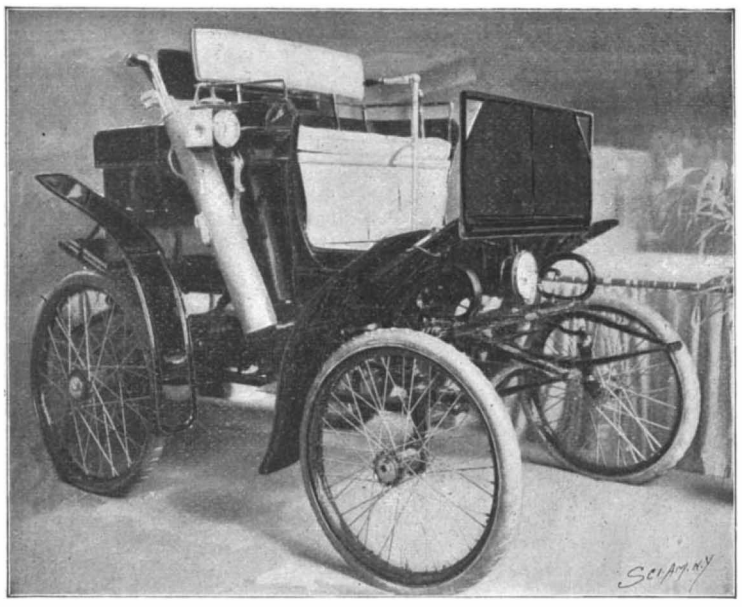
There were three separate exhibits of electric motor vehicles; in the Riker Electric Motor Company's booth we noticed a neat pattern of a phaeton popular in France, a three-wheeled runabout, and a covered delivery wagon. We shall hope to have illustrations of these at another time. The "Orient" electric runabout, it will be observed, is provided in the rear with a capacious battery space, having the controller lever on the left. The body is supported on a double trussed frame built of light steel weldless tubing. The front axle support is swiveled to allow for unevenness of roads, there being attached also steering rods which operate the two front wheels in combination with a center lever located in front of the driving seat. The raising of the lever, we will say, turns the wheels to the left, the lowering of it steers to the right. A foot lever connected underneath rearward, by diverging wire ropes to brake bands located near the hubs of the rear wheels, operates the brake. A three-kilowatt motor attached to the frame underneath gears into a special spur differential gear, thereby equally distributing the power on the wheels whether going straight or around a curve. The chloride accumulator battery is used and has an efficiency of 1,800 ampere hours or a discharge which will propel the vehicle for 25 miles on a level road. The size of the pneumatic tires on this vehicle is something remarkable.

An electric "Dos-a-Dos" exhibited by the Pope Manufacturing Company is one of the new forms of these vehicles. The controller lever is on the left hand side and the steering lever in the center. The seats are back to back, which provides ample room underneath for the chloride accumulator battery. A head light is located under the dash board, and two side lamps as well. Two motors are provided on the rear axle to be run at different speeds according to the position of the controller lever; an efficient foot brake is also provided. The vehicle is very substantially built, and with one charging of the battery will make twenty-five miles on a smooth, hard, fairly level road. A loaded golf case is hung from the side lamp, as if the vehicle was equipped to carry a golfing party.

It would seem, with the rapid and universal introduction of sources of supply of electricity and its production at a very small expense, there should be a remarkable increase in the near future of these motor vehicles.



THE ORIENT ELECTRIC RUNABOUT.



THE POPE ELECTRIC "DOS-A-DOS."

A Flashlight Explosion.

Again we have to caution our readers about the dangers of making and using flashlight powder. A chemist and photographer employed by the Telegraph Publishing Company, New York city, was compounding a flashlight mixture in the studio in West Forty-Second Street, on February 9, when the mixture exploded. The photographer was the only man in the studio at the time, and he was too badly injured to tell what actually occurred. The report of the explosion could, however, be heard a block. The tenants were badly scared, and so were the occupants of adjoining buildings. The explosion was followed by the sound of breaking glass, the concussion having been so great that it wrecked the glass skylight of the studio. The first person to arrive at the studio found the photographer's clothing ablaze and that he was severely burnt about the head, arms and body. He was taken to the New York Hospital, where his condition was said to be serious. The blaze in the building was extinguished without difficulty.

The Observatory at Manila.

It is feared that the heavy firing in the course of the recent engagement at Manila will have a serious effect on the usefulness of the observatory, which is famous the world over for its investigation on earthquakes and earth disturbances, and a great deal of knowledge concerning typhoons depends upon the Manila Observatory. When Dewey entered Manila Bay with his squadron on the first of May, the first shot warned Padre Doyle, who was in charge of the delicate instruments, of the necessity of sheltering them. The instruments were all buried, and observation ceased until General Otis notified him that the army and navy would afford him every protection in their power. The instruments were then exhumed, adjusted, and the recording of earthquakes and the forecasting of typhoons were continued as before. There was considerable anxiety as to the possible injury to the valuable and important instruments.

Death of William Laird.

William Laird, of the famous British shipbuilding firm of Laird Brothers, at Birkenhead, died on February 7. He will be principally remembered in connection with the construction of the Confederate war vessel "Alabama." At the time of the breaking out of our civil war the Messrs. Laird were the foremost shipbuilders of the world, and the "Alabama," which was completed in August, 1862, was the two hundred and ninetieth vessel which they had built. She was known as the "Two Hundred and Ninetieth" before she was christened by the Confederates. Naturally the firm was bitterly denounced by the people of the North for building her, and, of course, in due time the British nation paid the inevitable penalty for allowing the construction of this boat.

THE Westinghouse Electrical and Manufacturing Company has just received word that the newly organized French Westinghouse Company has obtained the contract for the equipment of the Paris Metropolitan Railway with the underground trolley. Several German and American concerns were competitors for the contract. The apparatus will be made at the company's works at Havre.

Russian Exploration in Asia.

Deserts are becoming comparatively scarce on modern maps. Little by little as they come to be explored it is found that the word desert should not be applied to the territory. The great Gobi desert in Asia is still put down in almost every atlas as an arid waste, but Russians exploring it have found it is not a desert, as has been supposed. Obrutscheff says that the physical features of the so-called Gobi desert show that it is not a sandy waste at all, but a plateau with all the characteristics of the Steppe. It was evidently once claimed by the sea, and its many hills and valleys are the results of a long erosion since its elevation above the sea. A precipitation occurs in all parts of the Gobi territory, and although it is not very plentiful, still the quantity of rain and snow produce a good growth of grass. The caravan route from China to Urga is traversed every year by about 100,000 camels with loads of tea, and the wells in the more barren part of the Gobi territory are usually not more than twenty or thirty miles apart. Wandering bands of Mongolians have large herds, and only in years of great drouth have they any difficulty in finding sufficient quantities of fodder. It was from the Gobi desert that great hordes of mounted barbarians issued who gave great trouble to China. It was these barbarians which caused the Chinese to erect the great wall, more than 1,200 miles in length, around the northern frontier of the empire. The wall, however, did not always prove effective in preventing their inroads.

British Columbia Museums.

Mr. Harlan I. Smith, of the Department of Archæology of the American Museum of Natural History, in a recent paper in Science, describes the Natural History Museums of British Columbia. Mr. Smith traveled all through British Columbia, spending about six months there, and he noted with interest the growth of scientific institutions, which he says exist to an unusual number in proportion to the population and number of educational institutions. The museums are exceptionally well administered, considering their isolation from other institutions. The most important among them is the Provincial Museum at Victoria. It is located in the east wing of the Parliament building. The Curator is now devoting special attention to preparing groups of birds and animals represented in their natural environment. He has been sent to great museums of the East and even to England to investigate the methods of preparing such groups. It is the general principle of museums to represent the fauna of the province, and visitors from foreign countries see at a glance the natural treasures of the region. This rich mining region is naturally productive of fine mineral specimens, which are well represented in the museum. The labeling of the collection put to shame many of the museums in the East, says Mr. Smith. New Westminster, with a population of only 8,000, made a splendid beginning toward establishing a museum in the upper portion of the city library, but, unfortunately, a fire on the 11th of last September destroyed the library and the collection.

Guam a Maritime Legal Fiction.

Guam, in the Ladrone Islands, which has now passed into the possession of the United States, has had a most curious use, for every year thousands of vessels clear at custom houses for Guam, yet none of them ever go there. Guam seems to be a maritime Tom Tiddler's ground. When a vessel clears for a certain port, it must go to that place by the shortest route of sailing, unless turned away from it by stress of weather, and any failure to do this calls at least for an explanation. It is not always desirable to declare the destination of vessels, specially among tramp traders who may wish to avoid carrying mail, or who may wish to pull the wool over the eyes of business rivals. In cases of this kind, the vessel clears for Guam and then usually sails away in exactly an opposite direction, and the law appears to be satisfied. This extraordinary state of affairs is based on old traditions of Spanish exclusiveness in trade in the East and West Indies. Owing to force of circumstances over which they had no control, the Spaniards found it desirable to open the Indies to trade, and in the early part of the century the old restrictions were removed; but by some chance the Ladrone Islands were not included, and, in accordance with the laws of the Indies, every vessel calling there without leave from the Spanish authorities to do so was forfeited. Of course, the penalty of the law has not been exacted for many years, but its existence has given rise to the legal fiction of clearing for Guam. It is probable that Guam will now prove less popular.

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Correspondence.

The Strangest Insect in the World.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to my contribution, page 375 of the SCIENTIFIC AMERICAN, December 14, 1895, vol. lxxiii., No. 24, I am now enabled to afford further information on the above subject, viz.: The fungus Sphæria Robertsii, Hook., is believed to attack rubriviridans, another species of the genus Charagia, as well as Hepialus virescens, besides other members of the Hepialidæ family, such as Porina and Pielus, chiefly the larger brown moths of these genera, with variously checkered markings according to sex. They are root feeders as a rule on the Rata, Metrosideros robusta, fern trees, etc. The popular names of S. Robertsii are bulrush caterpillar, New Zealand vegetable caterpillar, fungoid caterpillar and the additional Maori names Weri and Anuhi (Taylor). They are considered by entomologists to be the true subterrean root-eating insects of the genera Porina and Pielus, well defined groups of the family Hepialidæ. I was fortunate enough to discover on my land at Paraparaumu, near Wellington, New Zealand, a larva of Porina signata evidently attacked by this fungus, and in grubbing up roots and stumps in clearing the same land I obtained several larvæ of signata. The larva of this insect is about 2¼ inches in length, chocolate colored, with black head and dirty bluish white segmental rings; altogether a fragile, thin skinned, glabrous looking creature, seemingly unfitted for an underground life. The inclosed very interesting paper from Mr. Fitton, of Fielding, North Island, N. Z., would appear to set at rest any doubt as to wood-boring larvæ being exempt from attack by S. Robertsii. The subject of parasitic fungi has engaged the attention of many scientific men, notably that of Dr. M. C. Cooke, M.A., LL.D. See his valuable treatise on Entomophytes or Entomogenous Fungi and their insect hosts, 354 pages, four plates and woodcuts, 1892, London, published under the auspices of the Society for Promoting Christian Knowledge, and entitled "Vegetable Wasps and Plant Worms." Fungi parasitic on insects appear to have been first noticed as far back as 1763 in the "Philosophical Transactions of the Royal Society," and Hepialus virescens, formerly Cordyceps Carvarum, Westw., has been long considered, though open to doubt, as attacked by S. Robertsii. Much is known as to the ground larvæ attacked, but little as to the "modus operandi" of the fungus. The matter is now still further complicated by wood-borers being also attacked, making it inconceivable how the spores of the fungus obtain access to boring larvæ, converting their tissues into woody fiber; especially when it is considered that borers live in the hearts of the trees and secure themselves in their burrows from intrusion internally by ingeniously constructed diaphragm-like impediments, and externally by spinning thickish web coverings interwoven with fras and fragments of bark to close and disguise the entrance to the borers. Mr. Fitton's paper is evidently the result of years of careful observation, and as it probably contains the latest information on this important subect, you may be pleased, in the interests of science, to give it space in your widespread and valuable journal.

GEORGE J. GRAPES.

5 Terrace Road, St. John's, Newport Isle of Wight, England, December 30, 1898.

THE VEGETABLE CATERPILLAR.

The grub is the larva of a large moth, which, from its nocturnal habit, is commonly called "the night butterfly." The grubs (which are 2 to 3 inches long) are subject to attacks from a vegetable parasite, or fungi, called Sphæria Robertsii, the spores of which, germinating in the body of the grub, absorb or assimilate the whole of the animal substance, the fungus growth being an exact replica of the living caterpillar. As to how the spores of the fungi are taken into the body of the grub, it is idle, in the absence of more knowledge of the organisms, to speculate. The fungi, having killed the grub and absorbed the animal substance, sends up a shoot or seed stem, the length of which varies from 6 to about 11 inches. A remarkable feature about the seed stem is that it always breaks through the skin of the grub at the back of the head. Those caterpillars found are in a vertical position, with the head uppermost; but this does not seem to account for the stem breaking through at the head, as among the hundreds I have dug up I found two with the position reversed, the head downward, and in both these cases the stem had, as usual, broken through at the back of the head. The ground caterpillar is found at a depth of 2 to 8 inches below the surface of the ground; the stem below the surface being generally twisted and bent through coming in contact with roots or other hard matter. Above the ground the stem is straight, about 2 inches of the upper end being covered with the seed spores. It is accepted opinion that the fungi, after producing its spores, dies and decays, but this is incorrect, as only that part of the stem above the ground dies, the lower portion retaining its vitality and sending up another shoot the following year, the new shoot sprouting from the old just a little below the surface of the ground. Among the many specimens dug up I have found two with the wings and legs of the moth showing beneath the outer integument, thus showing that the transformation to the winged moth was in operation before the grub was attacked by the fungi. There is a tree-boring grub exactly like the ground one, but whether the two are identical has yet to be determined; however, the tree-boring one is also subject to attacks of S. Robertsii, as I have found one with the seed stem growing from the head, the stem projecting out of the bore the grub had made, the end of the stem standing out about 3 inches beyond the bark of the tree. A friend of mine has also found two others in trees. It is believed the ground grub only enters the ground at the time when about to go through its transformation to the moth; but this belief is open to question, and may well be doubted. The strongest reason for doubting it is the fact, established beyond all question, that the tree-boring grub changes to the moth without leaving the tree. When about to enter on the winged stage of its existence, it crawls to the outer end of its bore, slips its outer membrane and emerges a fully developed moth. Hundreds of the empty membranes may be observed during the early weeks of summer. Another reason for doubting the accepted belief is that live grubs can be found in the ground at all seasons of the year. Those grubs which escape being attacked by the fungi appear as winged moths about the middle of October. Their existence in the winged stage seems to be very brief, limited to two or three weeks. In about three weeks after their first appearance none can be seen, but dead ones may be found on roads or in open places in the woods. Some of the moths are of large size, and beautifully marked. There is such a variety of color among them that scarcely two can be found of exactly the same shade. The caterpillars are scattered over a large area of country, but are only found in bush covered land, the stems sticking up through the decayed leaves and looking like a miniature bulrush. Such is the "vegetable caterpillar," an organism calculated to arrest the attention of anyone, and furnishing another example that the animal and vegetable life on the globe is so intertwined as to be inseparable.

[Signed] C. FITTON.

Rangiwahia, Pemberton, Fielding, New Zealand.

The Nernst Electric Lamp.

The Nernst electric lamp is now creating considerable interest abroad. At a meeting of the Society of Arts on February 8, Profs. Swinburne and Ayrton put themselves on record as saying it was the greatest discovery in many years. The invention created great interest among the members of the Society who were present at the meeting. In the invention of Prof. Walter Nernst, of Goettingen University, the light is emitted by a rod composed of oxides of rare earths similar to those which are used in the manufacture of incandescent gas mantles. The light is mild and yellowish and works equally well at considerable variations of voltage. Magnesium oxide is largely used in the manufacture of rods, and like the other material it is incombustible. The materials used are, under ordinary circumstances, non-conductors of electricity, and Prof. Nernst's discovery is that when they are heated they become conductors. In experiments with a hollow magnesium tube he obtained results which showed an expenditure of 0·96 watt of electrical energy per candle power against 3 watts per candle power for the ordinary glow lamp. Up to the present time Prof. Nernst has not settled upon a commercial form for his lamp. In his experimental lamp he accomplishes the initial heating of the magnesium filament by placing it in the focus of a reflector under which is also a spiral coil of platinum wire. The current is first passed through the platinum, which furnishes heat enough to the focus of the reflector to render the magnesium conductive. The current is then turned on, and the magnesium becoming incandescent gives out light and also enough heat to maintain its own conductivity.

A Curious Bridge at Mans, France.

There has recently been completed at Mans a bridge which is most curious, from a technical point of view, and remarkable from an artistic point of view. In the town of Mans, an electric tramway had been constructed which was to run across the river at a certain point. The steam railway of Saint-Denis-d'Arques, in operation since 1888, crossed the river at the same point. If the two roads crossed on land, two bridges would be required. The old railway bridge could not be used, as it was already worn out by long service. It was therefore decided to build a single bridge with two branches, thus leaving passages for the railway and the tramway. The structure, as a result, is X-shaped, and the two roads cross each other in midstream. By reason of this peculiar structure a saving of 12,000 francs was effected—a very considerable sum, when it is considered that two bridges would have cost 45,000 francs.

Science Notes.

A fossil dinosaur that must have been 130 feet in length has been found near Laramie, Col. The remains were found by Prof. W. H. Reed in the Jurassic strata near Laramie.

The Indian government has been offered by Mr. Jamestsji Tata the sum of $1,250,000, for the establishment in India of a university for research on the model of the Johns Hopkins University.

Mr. H. Holswaldt has devised an improved mercury interrupter. It consists of a three-rayed star wheel made of silver. The arms are narrow, and flattened so they enter and leave the mercury without noise.

A Chicago concern building automobile vehicles has closed a contract to supply several Bombay princesses with them. They will be actuated by electricity. The same company is now estimating the cost of a line of automobile coaches for Fifth Avenue, New York city.

Oil to calm the waves was used on an unusually large scale during the recent gales in the English Channel. The waves broke over Folkestone pier, making it difficult for steamers to enter the port until a considerable quantity of the oil was poured into the harbor, when the seas immediately became smooth.

Dr. Negro, of Turin, has succeeded in curing one hundred out of one hundred and thirteen cases of sciatica by digital pressure over the painful part. The pressure is applied with all possible force for fifteen or twenty seconds and is repeated for the same length of time after an interval of a few minutes. In many cases six treatments are all that is necessary.

On January 21, W. A. Eddy, of Bayonne, N. J., sent up an electrical collector to a great height by means of four kites, each 7 feet in height. The collector had four 6-inch cardboard points covered with tin-foil. Thin bare copper wire ran down the kite cord and into Eddy's house. The sparks which were obtained were much smaller than Eddy had expected from a collector raised to such an elevation.

We have already spoken of the extirpation of a woman's stomach, the very clever operation being performed by Dr. Schlatter, of Zurich. It is interesting to note that two operations of a similar nature have since taken place in this country, and both were successful. One was performed in San Francisco by Dr. Brigham and one by Dr. Maurice Richardson, of Boston. In the latter case the patient was an elderly lady who had a cancerous growth which involved the whole stomach, so that the only remedy was the removal of the organ. The patient recovered and is now quite well.

A German chemist, named Liebermann, calls attention to the fact that a certain class of factories which manufacture chemical apparatus have, for some time, been putting on the market test tubes, etc., of a glass so strongly alkaline that if red litmus tincture or other delicate testing solutions are put into them, the reagents at once take on a color reaction as intense as though an alkaline solution had been poured into them. Such vessels might readily be the source of enormous errors; but for this great defect, the author says that the vessels are brilliant and well made. There is nothing which calls for higher excellence than chemical apparatus and chemicals.

The grounds and buildings of the Exposition of 1898, at Omaha, have been purchased by a company formed to hold an exposition this year to be known as "The Greater American Exposition of 1899." The exposition is to consist of exhibits from the new possessions of the United States. Resolutions have been presented to Congress to gain recognition for the project, and to request the admission of the exhibits duty free. It is proposed to open the exhibition on July 1 and close it on November 1. It hardly seems as if the time has arrived for an exposition which deals with our newly acquired territory. Everything is at present in a chaotic state, and we doubt very much if an adequate display can be made.

We recently examined what is thought to be one of the largest studio cameras ever built in this country, made by Folmer & Schwing, of this city. The bed of the camera measures seven feet, but the focus can be extended three feet more by the addition of a bus extension front. The rear moving section is supported on roller bearings to permit of easy focusing. It takes a plate forty inches square. The plate holder is of special construction, having a sectional flexible roller blind slide, made of half inch strips of wood, tongued and grooved together, and passes through one edge of the holder from the front to the rear. When an exposure is made, the end of the slide is pulled downward until it completely covers the back of the holder and at the same time uncovers the plate in the camera. Pushing it upward covers the plate again. The weight of such a shutter is thus somewhat balanced, except when it is first started, one part being on one side of the holder and the other part on the other side. Usually a small test plate is tried first to secure the correct exposure before using the large plate, which costs about $10.

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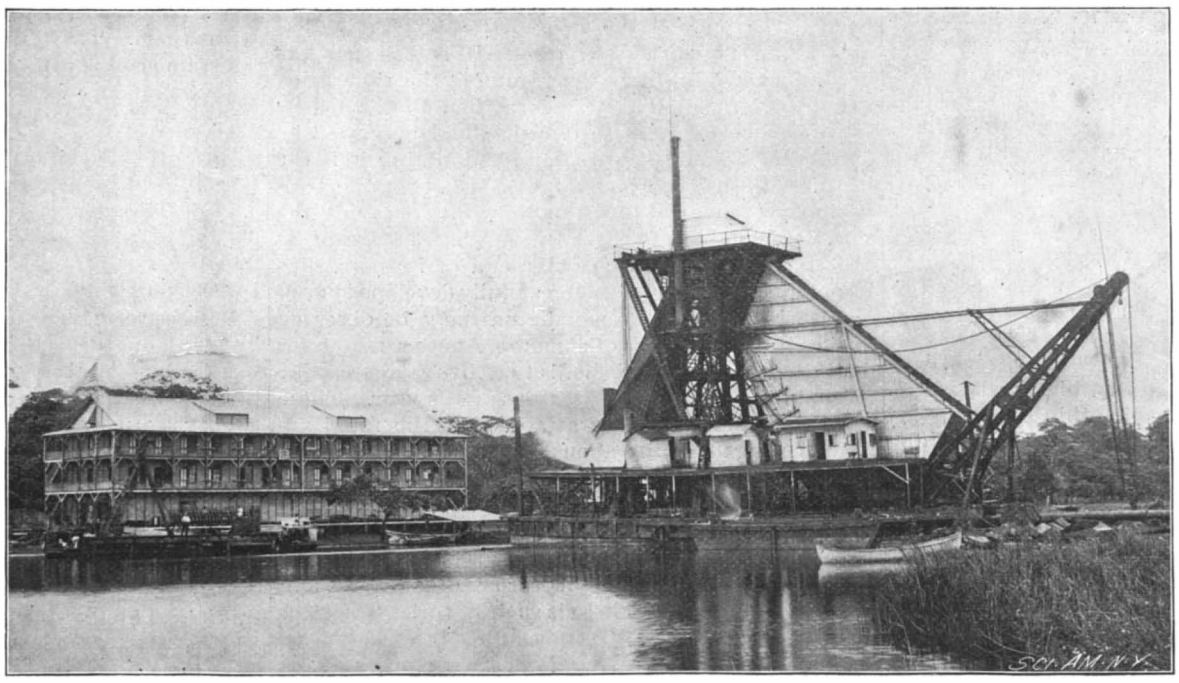
THE PROPOSED NICARAGUA CANAL.

Our issue of February 4th contained the first of two illustrated articles which will give a comprehensive description of those two colossal undertakings, the Panama and Nicaragua Canals; the former of which, as our article showed, is surveyed and already two-fifths completed, while the latter is now being surveyed, with a view to determining its feasibility and cost. We take it that it is too late in the day to present arguments to prove that a canal at the isthmus would have great commercial and strategic value—that is universally admitted.

The question is one of site, practicability, and cost. Beyond demanding that the canal as completed shall be the cheapest and best that can be built and shall secure to the United States every advantage to which it is justly entitled of a commercial, strategic and political character, we believe the public is indifferent as to whether the canal is cut through at Panama, Nicaragua or elsewhere.

Probably there is no question involving such an enormous outlay of the public money upon which the people of the United States are so little informed as they are upon the relative standing and merits of the two proposed canals. The present articles are written with a view to giving such an impartial statement of the facts as shall enable the reader to judge for himself of the relative merits and demerits of the rival schemes.



CANAL COMPANY'S STOREHOUSE AND DREDGE AT LA FE, GREYTOWN.

A glance at the map and profile of the proposed route of the Nicaragua Canal is sufficient to explain why it is that from the earliest times it has attracted attention as affording a feasible means of ship communication across the isthmus. The mountain range known as the Cordilleras, which forms the divide between the drainage of the Atlantic and Pacific, separates at a point about 70 miles north of Lake Nicaragua into two branches, one of which extends in a southerly direction between the lake and the Pacific, while the eastern divide runs parallel with and some 18 miles to the east of the lake and then in a southerly direction until it terminates near Greytown on the Atlantic coast. Lying within the V formed by these ranges are Lakes Managua and Nicaragua, and into these lakes, which are connected by the river Tipitapa, there empties the drainage of this basin, which has an area of 12,000 square miles, the area of Nicaragua being somewhere between 2,700 and 3,000 square miles.

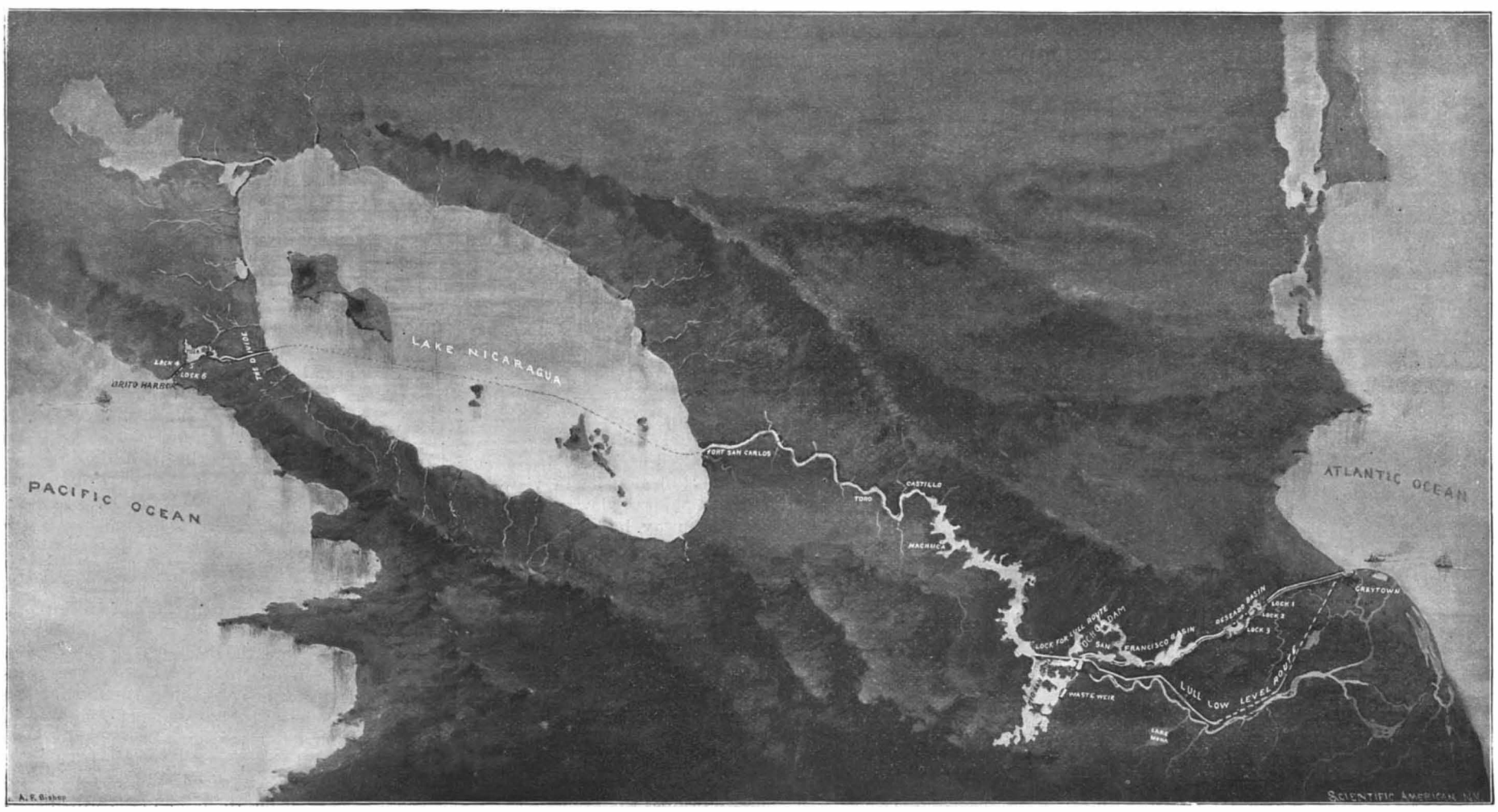
The lake is 45 miles wide by 110 miles long, and it extends in a general southeasterly direction, its longer axis being parallel with the Pacific Ocean, which at the nearest point is only 11 miles distant. The lake is for the most part deep, and its waters have a mean surface level of 106 feet above sea level. The only outlet for the waters of the lake is by the way of the San Juan, a noble stream of great volume with an average width of 1,500 feet, a minimum discharge estimated at 12,000 cubic feet per second, and a flood discharge which has been estimated by some authorities as 60,000 and by others as high as 150,000 cubic feet per second, the latter amount being two-thirds the average flow of Niagara itself. The river flows for 120 miles to the Atlantic and is navigable for river steamers, except at some rapids, which in the dry season offer obstruction. On the north side but few streams flow into the San Juan, but the streams that enter it from the south are large and subject to heavy floods which carry down immense volumes of sand from the Costa Rican range some 50 miles distant. The most turbulent tributary is the San Carlos, which flows into the San Juan above Ochoa. The sand and volcanic ash thus brought down are carried by the San Juan and Colorado to the coast, where an extensive delta has accumulated and is steadily encroaching upon the sea.

The navigability of the San Juan and the lake, and the narrow divide separating the lake from the Pacific, have, from very early times, suggested the possibility of opening a ship canal across the isthmus at this point, and surveys of a general and preliminary character looking to this object were made as long ago as the close of the eighteenth century.

THE CHILDS SURVEY, 1852.—The first actual survey for a canal was that made in 1850–52 by Col. O. M. Childs, an expert canal and railway engineer of great distinction, for the Transit Company, which had a steamer and stage line across the isthmus as part of a route from New York to California. Steamers ran up the San Juan from Greytown and crossed the lake to its west coast, where they connected with a stage line to the Pacific. The survey was for a waterway with a depth throughout of 17 feet. In the canal portion the bottom width was to be 50 feet, while in the excavated channels in the river and lake the bottom width was to be 150 feet. Locks were to be 250 by 60 by 17 feet. Ships were to pass from the sea level on each side to the summit lake level of 108 feet by 14 locks, each with an 8-foot lift. The lake was to be held at 108 feet elevation by a dam in the Rio Grande valley 9¾ miles west of the lake and another at Castillo Rapids 37¼ miles east of the lake in the San Juan River. The lowest lock on the east side was to be at a point 90 miles from the lake, where the canal was to leave the river and extend across the flat alluvial land to Greytown, where at that time there was a well protected harbor. The total length of the Childs canal was to have been 194·4 miles, and its cost, including 15 per cent for contingencies, was estimated at $31,538,319.

THE LULL SURVEY, 1873.—The United States government sent an expedition to the isthmus in 1872 under Commander Lull, U. S. N., for the purpose of making a resurvey of the Childs route. With Commander Lull was associated Mr. A. G. Menocal, the present engineer of the Maritime Canal Company. The depth of the canal was to be 26 feet and its bottom width 50, 60, and 72 feet, according to locality. In the excavated river channel the bottom width was to be 80 feet and something over 80 feet in the lake channel.

Commander Lull proposed several changes. The Pacific terminus was to be the same as that proposed by Childs, namely, Brito. The ascent from the Pacific coast to the lake was to be by way of the Rio Grande Valley, and by means of 11 locks of 10½ feet lift, and the canal was to be cut directly through the western divide to the lake. This portion was to be 16¼ miles long. The route across the lake was to be 56½ miles long: The San Juan was to be navigated



BIRD'S EYE VIEW OF THE PROPOSED NICARAGUA CANAL.

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by placing dams in the river at four places, the uppermost at Castillo, the lowest a mile below the mouth of the San Carlos. This river portion was to be 66½ miles long. At the lowest dam the canal was to leave the river, follow its left bank to the San Juanillo, and then proceed by a straight course to Greytown. The total length of the canal from ocean to ocean was to be 181¼ miles. As Greytown Harbor had been silted up since the Childs survey, an estimate of $2,500,000 was made for its restoration. The total cost of the project, including 25 per cent for contingencies, was estimated as $65,722,147.

THE MARITIME CANAL COMPANY'S SURVEY, 1887 to 1890. — The next step was taken in 1885, when Mr. Menocal was directed by the government to make a re-examination of the work, and estimate for the construction of a 28-foot canal. In his report of that year he recommended some very radical changes in the Lull plan and outlined a project which involved some bold engineering measures, especially in the canalization of the San Juan River. The total estimate for the canal was $60,036,197. Four years later Mr. Menocal returned to the isthmus as chief engineer of a company (the Maritime Canal Company), which had been formed for the purpose of building the canal on the general lines proposed by him in the 1885 report. A large engineering force was put in the field between the years 1887 and 1890, and in the latter year a report was presented by Mr. Menocal and elaborated in the Chicago Waterways Congress of 1893, setting forth the data and plans upon which it was proposed to build the canal.

SAN JORGE LANDING ON THE WEST SHORE OF LAKE NICARAGUA. OMETEPE MOUNTAIN, 5,350 FEET, IN THE DISTANCE.

It is admitted by the many expert engineers who have criticised the Menocal project that if it were possible to eliminate from it certain elements of danger, it would provide a canal which would be in every way superior to the other alternative plans which have been submitted. Its most striking feature was that it proposed to extend the summit level of 110 feet almost from ocean to ocean. This was to be done by the construction of two great dams, one at La Flor on the Pacific slope of the western divide, at a narrow gorge in the Rio Grande Valley, 3·8 miles from the Pacific, and the other at Ochoa, a point on the San Juan, 3½ miles below the San Carlos River and 64½ miles from the lake. The Ochoa dam would rise 60 feet above the water surface of the San Juan at that point and would cause its waters and those of the San Carlos to back up and flood the two valleys, converting them into lakes which would actually form extensions of the Nicaragua Lake itself. An important feature of the design was the use of the San Carlos Lake as a settling basin for detritus brought down from the mountains. La Flor dam on the Pacific, being placed below the mouth of the Tola, a tributary of the Rio Grande, would similarly flood the Tola Valley, converting it into another lake at the level of and forming part of the big lake.

Nor was this all. With a view to shortening the route and still further extending the summit level, Mr. Menocal proposed to proceed to Greytown, not, as Lull and Childs advised, by way of the marshy lowlands through which the San Juan finds its way to the sea, but by a direct route across the intervening ridges and valleys, and through the crest of the eastern divide. To do this he proposed to raise embankments across the lower side of the valleys and make cuttings through the intervening ridges, and allow the San Juan waters to flood the basins thus formed, the embankments being built to the same heights as the Ochoa dam and serving to maintain the summit level right through the eastern divide and up to lock number 3 (see profile). The portion between the Ochoa dam and lock 3 would thus consist of two large artificial lakes, known as the San Francisco and Deseado basins, connected by short lengths of canal. Lock 3 is only 13 miles from the Atlantic (Caribbean Sea), so that by this original and daring proposal the summit level would be extended continuously for 154 miles across the isthmus, its eastern terminus being within 13 miles and its western terminus within two miles of the respective oceans. On both sides descent was to be made to sea level by three locks. At the Pacific level the lowest lock would be within a mile of the deep water and on the Atlantic it would be necessary to dredge a canal 9·4 miles in length through the alluvial deposits of the river.

CONSTRUCTION OF DAMS.—Now, to construct a dam 60 to 80 feet high across a great river whose waters in time of flood may be over one-half as great in volume as the flow of Niagara is a stupendous undertaking. Mr. Menocal evidently realized that it was hopeless to divert the river, lay bare its bed, expose the underlying rock, and build up an impervious dam in the ordinary way, for he proposed to make a high, loose-rock fill across the river, dumping in the material excavated from the big cut through the eastern divide in as large blocks as possible. The rock, of which the cut would afford an abundant supply, was to be dumped in until it had ceased to sink into the soft bed of the river and a stable structure had been secured. To render it impervious, the excavated clay from the neighborhood was to be dumped upon the upstream face of the dam. A similar method of construction was to be used for the numerous embankments of the San Francisco and other streams crossed by the canal, and for La Flor dam. The most startling proposal of all, however, was that to use the rock-fill dams as weirs over which the surplus waters of the lake and rivers were to discharge.

HARBORS.—All the surveys that have been made for a canal have realized the necessity of creating terminal harbors at each seaboard. On the Pacific the canal terminates at Brito, an indentation of the coast, while at the Atlantic it ends on the shifting sands which have silted up what was once the deep-water harbor of Greytown. At Brito both Childs and Lull estimated that a new harbor would cost about two and one-half million dollars, while the Maritime Company's estimate put it at about one and three-quarters million dollars. It was proposed to create the harbor by running out projecting jetties and dredging out an interior basin. The construction presents no problems that are novel or untried in engineering practice. At Greytown, however, as a study of the accompanying maps will show, the problem will require careful study, and after the harbor is complete will call for continual dredging and successive additions to the jetty. To understand the conditions we must bear in mind two things: First, that for ten months of the year the trade winds and seas move upon the beach from the northeast; second, that enormous masses of volcanic silt are brought down by the San Juan and deposited, through the Colorado branch, at its mouth, to the eastward of the harbor. The waves, striking this material at an angle with the coast, transport it to the westward to the amount, as estimated by the present Walker Board, of 600,000 cubic yards per year. This remarkable drift is seen in the map of the Peacock survey of 1832, in which the westward travel of the sand is shown from 1832 to 1859. The progress of the sand spit has been accompanied by a shoaling up of the harbor until in 1895 the once capacious harbor with its low water depth of 30 feet has shrunk to a mere lagoon with a maximum depth of 17 feet. To open a channel from the canal to deep water the company built a pile and rock jetty 900 feet in length. This was done for the purpose of arresting the westerly drift and enabling them to dredge a channel on its western side. The sand accumulated on the eastern side of the jetty, reached the outer end, flowed past it, and formed the curious tongue which is seen extending past the jetty and almost across the entrance channel. This result shows that while it will be possible to obtain an entrance by extending the jetty far out to deep water, the filling in of the beach behind it at the rate of 600,000 cubic yards per year will be perpetual, and the jetty will require to be extended at recurrent intervals. As there is no tidal scour to rely upon, the channel will have to be maintained by the use of dredges. The company's proposi-

VIEW SHOWING SPOIL BANK THROWN UP BY DREDGES AT WORK IN CANAL. RAILROAD RUNS AT BASE OF BANK.

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tion was to build an east pier 3,000 feet long and a west pier about 2,000 feet in length, with an entrance 600 feet in width. The entrance channel, 5,000 feet long, was to connect with an artificial basin 237 acres in extent, dredged out in the Greytown Lagoon to a low water depth of 30 feet. The total cost of the whole scheme, including the harbors, was estimated by the company at $65,084,176.

WORK DONE BY THE COMPANY.—A start in construction was made by the company at the Greytown end. Five large dredges commenced cutting through the alluvial deposits through which the first 9 miles of the canal will be cut. Some 4,500 feet of the canal were cut to a depth of 16½ feet and the canal line through the dense tropical growth was cleared for a distance of 32 miles. A single track railroad was built from Greytown, 11 miles into the interior. The jetty above mentioned was built out 900 feet, and a 17-foot channel dredged from the sea to the Greytown Lagoon.

THE LUDLOW COMMISSION. — The operation of the canal company ceased in 1893 for lack of funds. In 1892 the Senate Committee on Foreign Relations introduced a bill providing for the aid of the United States in the construction of the canal by a guarantee of the bonds issued for construction, and in 1895 Congress appointed a commission consisting of three well known engineers, Colonel Ludlow of the army, Civil Engineer M. T. Endicott, of the navy, and Alfred Noble, a civilian in private practice, for the purpose of reporting on the "feasibility and cost of completion" of the company's project. After examining the route on the isthmus and the engineering data collected by the company, the commission reported that while a ship canal project was feasible, they were unable to indorse several important features of the company's plans. They considered that the data upon which the plans were drawn up was neither sufficiently detailed nor spread over a sufficient period of time to enable accurate conclusions to be drawn, either as to permanence of the proposed structures or the cost of the undertaking as a whole. They considered that the quantities of dredging, excavation, etc., were underestimated, and that the unit prices had been placed too low. They raised the quantities and prices accordingly, and made an estimate of their own which placed the probable cost of completion at $133,472,893, as against the company's estimate of about $67,000,000, an increase of 100 per cent.

The features most severely criticised by the commission were the two great rock-fill dams at each end of the summit level, one at La Flor, 2,000 feet long and 90 feet above the bed of the river, the other at Ochoa, 1,900 feet long and 60 feet above the river bed, and the extension of the canal through the San Francisco basin, where it would be necessary to construct 67 clay dams or retaining embankments, one of which is 1¼ miles in length and rises 100 feet above its foundations. It was also stated by the board that they found indications of an extreme variation in the level of the lake in wet and dry seasons of 15 feet, and that this variation, extending over an area of nearly 3,000 square miles, represented an enormous volume of water, which it might prove extremely difficult to hold at the desired elevation of 110 feet.

The board suggested that a more thorough examination of the locality might disclose alternative routes which would be free from the objections outlined in their report, and they suggested that $350,000 should be appropriated for a further examination to finish the investigation and prepare final plans and estimates. This recommendation was acted upon, and a new commission consisting of Admiral Walker, Prof. Lewis M. Haupt, and Gen. Hains spent three months in a personal examination of the route and placed in the field a well equipped force of 250 men, including 80 engineers, a geologist, a hydrographer, ten boring outfits, and a very complete set of apparatus for determining rainfall, evaporation, flow of streams, and all the natural phenomena affecting the construction and maintenance of the canal. The expedition landed in December, 1897, and the observations, plans, and estimates are still in progress, and will not be fully completed for some time.

At a preliminary hearing before a select committee of the Senate the members of the commission roughly estimated the cost of construction as follows: Admiral Walker, $125,000,000; Prof. Haupt, $90,000,000; and Gen. Hains, $140,000,000. In a preliminary report, issued at the close of last December, the commission states that of all the routes that have come up for consideration, the two best are the Maritime Canal Company's route, known as the high level route, and the Lull or low level route. The estimated cost is $124,000,000 for the latter and $125,000,000 for the former. Gen. Hains, however, who is the oldest and most experienced member of the commission, states in a supplemental note to the report that he thinks the estimate should be raised to about $150,000,000.

All these members of the commission "believe that the construction of a canal across Nicaragua is entirely feasible."

RECOMMENDATIONS OF THE WALKER COMMISSION. —Although some time must elapse before the final report is made public, we are in a position to state what will be the general features of the plan finally recommended by the commission. In the first place, the Ochoa dam will be moved up the river to a point above the San Carlos, with a view to eliminating the torrential floods and the silt of that river, which will be allowed to pass away in the ordinary manner through the San Juan.

No attempt will be made to hold the summit level up to the Ochoa dam; but an intermediate dam and a lock will be placed at one of the upper rapids—probably Machuca—and the level will be lowered 20 or 30 feet at that point. This will reduce the height of the Ochoa dam by nearly one-half, and the canal will be carried from Ochoa down the left bank of the San Juan to a point at which it will strike off across the divide in the same manner as, but at a lower level than that proposed in the Menocal scheme. This will increase the cuts but reduce the heights of the embankments, thereby avoiding the risky features of the high level route. This route will be in the nature of a compromise between the high level route of the company and the low level route located by Lull.

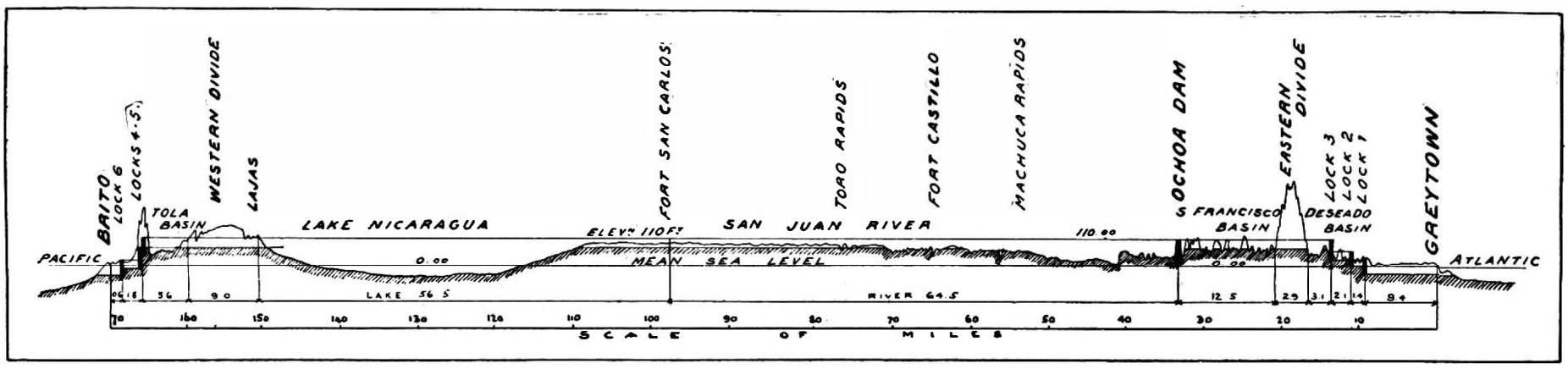
The security of the Ochoa dam is further assured by the discovery of solid rock everywhere underlying the bed of the river at the proposed site, and a firm clay has been developed along the site of the embankment foundations. The Menocal idea of using the dams as overflow weirs has been abandoned; separate weirs will be provided in every case.

The commission finds that it can regulate the level of the lake within a recorded fluctuation of 2½ feet above and below the normal. On the west side of the lake, La Flor dam and Tola basin are abandoned. The canal will be cut through the divide to the Rio Grande, and it will be carried down to sea level at Brito by means of locks whose number has not been determined. To assist in controlling the lake level and relieving the duty thrown upon the San Juan, it is not unlikely that the canal through the western divide will be given considerably greater width to enable it to assist in carrying off the surplus waters in the seasons of flood.

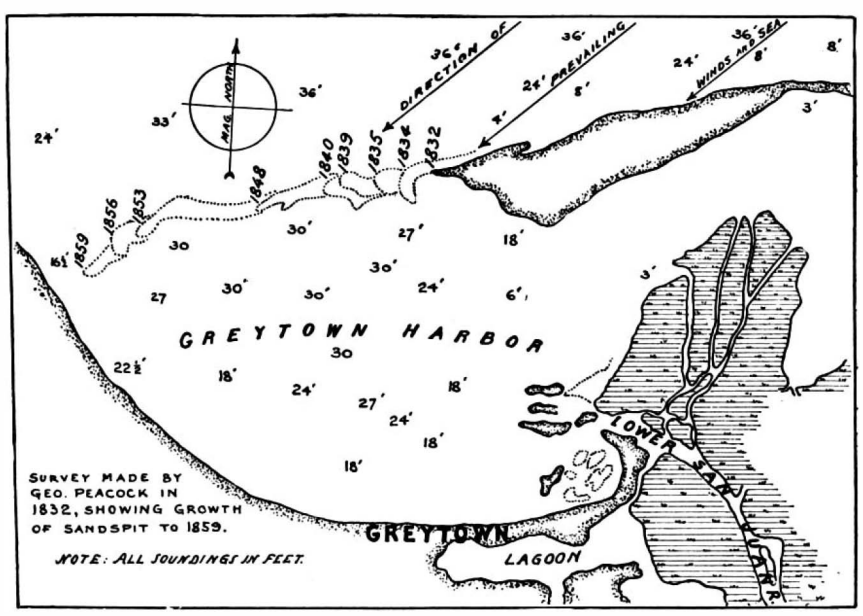
The least depth throughout of the canal will be 30 feet. All excavated channels will be given extra width both in the river and lake, while the curvature will be eased to render navigation less difficult. All locks will be of a length and depth to accommodate the increasing dimensions of modern steamships.

Finally, the commission is of the opinion that while the rainfall is excessive (22 feet on the eastern section), the material will stand up remarkably well in excavation. Moreover, the climate, on account of the prevailing trade winds, is not unhealthy, and it is not apprehended that it would prove a hindrance to the prosecution of the work. The estimated time for completion is from eight to ten years.

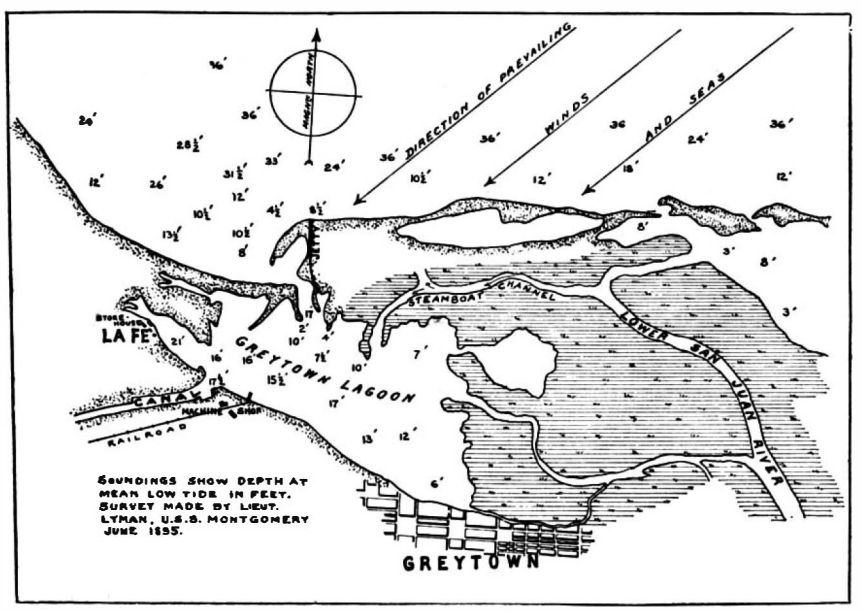
Such is the Nicaragua Canal. A comparison of its natural, commercial and political advantages with those of the Panama Canal will be found on another page.



PROFILE OF THE NICARAGUA CANAL AS PROPOSED BY THE MARITIME CANAL COMPANY.


DIRECTION OF PREVAILING WINDS AND SEAS
GREYTOWN HARBOR
LOWER SAN JUAN R.
GREYTOWN
LAGOON
SURVEY MADE BY GEO. PEACOCK IN 1832, SHOWING GROWTH OF SANDSPIT TO 1859.
NOTE: ALL SOUNDINGS IN FEET.

GREYTOWN HARBOR IN 1832, SHOWING GROWTH OF SAND SPIT TO THE WESTWARD UNDER ACTION OF PREVAILING TRADE WINDS.


DIRECTION OF PREVAILING WINDS AND SEAS
LA FE
GREYTOWN LAGOON
CANAL
RAILROAD
STEAMBOAT CHANNEL
LOWER SAN JUAN RIVER
GREYTOWN
SOUNDINGS SHOW DEPTH AT MEAN LOW TIDE IN FEET. SURVEY MADE BY LIEUT. LYMAN, U.S.S. MONTGOMERY JUNE 1895.

SITE OF GREYTOWN HARBOR (NOW A LAGOON) IN 1895. SAN JUAN DELTA HAS EXTENDED OUT TO SAND SPIT AND HARBOR HAS SHOALED TO 16 FEET.

Naval Engineering at Columbia University.

The Trustees of Columbia University, on February 6, decided to enter the field of naval engineering. William Ledyard Cathcart, Director of Marine Engineering and Designing at the Webb Academy, was appointed chief professor of mechanical engineering. He was recommended for the post by Commodore Melville, Chief of the Bureau of Steam Engineering of the Navy.

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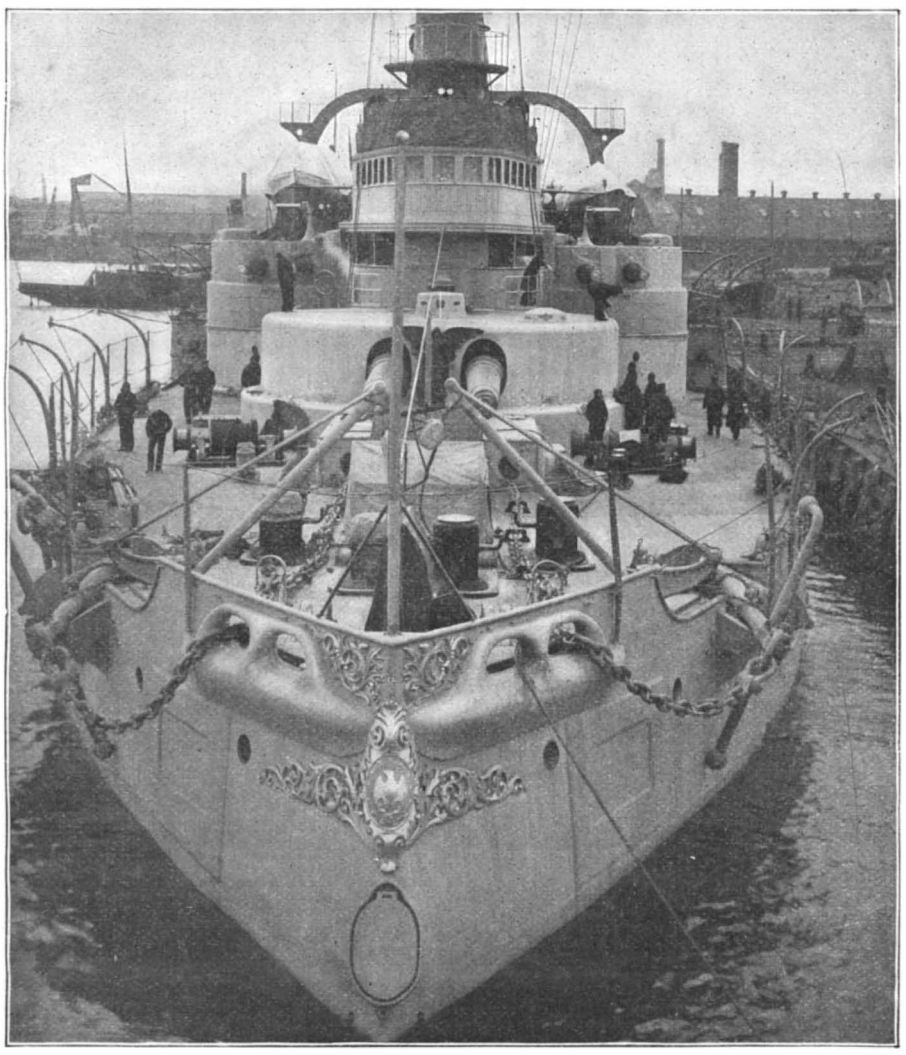
REPAIRING THE KEEL OF A BATTLESHIP.

The illustrations which we present in this issue of the difficult repairs of the keel of the "Massachusetts" which are being carried on in the large, new dry dock at the Brooklyn navy yard are of special interest. We are all perfectly familiar with the terms "double bottom," "cellular construction," etc., as applied to warship construction, but it is a novel experience to be able to look, as we do in these photographs, right into this complicated portion of the anatomy of the modern battleship. That the readers of the SCIENTIFIC AMERICAN are able to do so in the present instance, is due to the fact that the injuries to the keel of the "Massachusetts," when she recently grounded on a reef in New York Harbor, were so serious as to necessitate removing the plates of her outer bottom for a length of over 100 feet measured fore and aft, and for a considerable distance on either side of the keel.

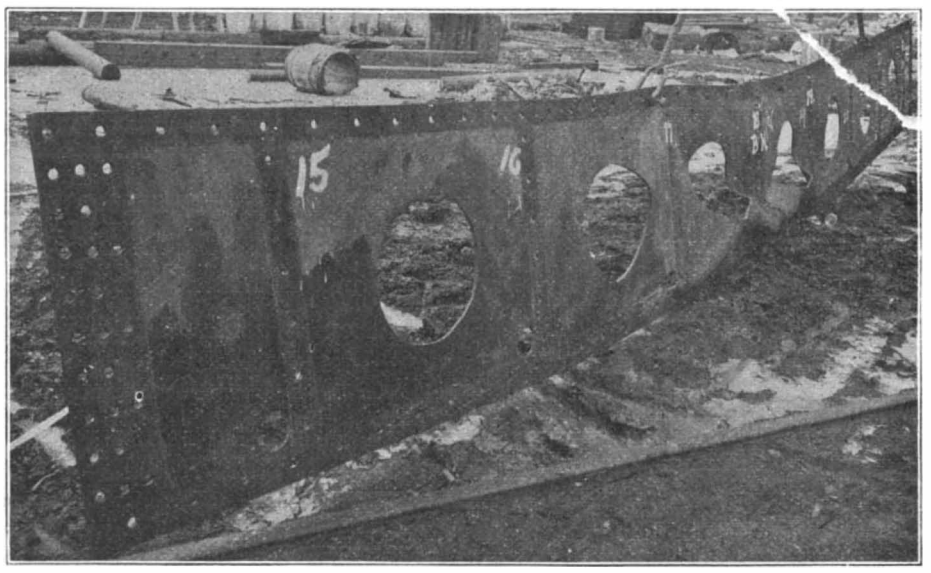
It will be remembered that this splendid vessel met with her mishap a few minutes after she had left the Brooklyn navy yard, with a full complement of coal, ammunition, general stores, etc., on board. She was drawing at the time 26 feet 4 inches of water, and it was supposed that she would be able to clear the shoals in the channel on her way down the bay with a safe margin to spare. As she was passing what is known as the Diamond Shoal, however (the dangerous reef which extends across the channel off Governor's Island), she touched bottom and forced her way bodily through the reef of sand. At the time of the grounding there was only 24 feet 5 inches of water above the shoal, so that the battleship had to cut a channel for herself, which was about 2 feet in depth. The reef consists chiefly of firm sand, and as the impetus of the vessel carried her through it the enormous pressure against her bottom buckled the outer plating between the frames, and in some cases buckled and pushed upward the framing itself. It speaks volumes for the excellent quality of the mild steel of which the ship is built, that only in a few cases was there any actual fracture of either frames or plating. A large number of the plates that were taken off the bottom were heated, straightened, and found to be perfectly serviceable for riveting into the ship again. The injuries extended from frame No. 16 for over 100 feet aft, and the correctness of the theories upon which the outer and inner bottom of a ship and the framing between them is constructed is shown by the fact that although the outer bottom is so badly crumpled, and the framing buckled and generally distorted, the inner bottom was found to be absolutely intact, and therefore thoroughly watertight. What flooding there was was confined entirely to the double bottom.

The repairs which are now being carried out on the ship are among the most difficult and expensive ever made in our navy. It is probable that they will cost between $40,000 and $50,000 before the ship again leaves the dry dock. Fortunately, the new dock, No. 3, which, it will be remembered, was handed over to Naval Constructor Bowles for repairs at the time of its collapse, has been placed in thoroughly serviceable condition and has proved to be absolutely watertight. When the "Massachusetts" returned to the yard, she was floated into this dock and the very difficult and delicate work of settling the big battleship, which weighs in all about 12,000 tons, upon the blocks, was carried out with a success which reflects the very highest credit upon Mr. Bowles and his assistants.

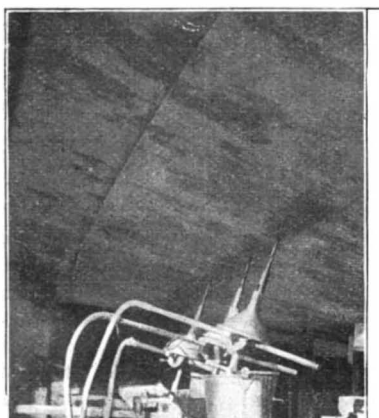
As we have often explained in these columns, when a ship is in dry dock her weight is carried by a line of keel blocks which are placed immediately beneath the keel, and by two lines of bilge blocks, one on each side of the vessel. In the present case it was impossible to support the forward injured portion of the vessel upon the keel blocks, and the weight had to be carried by means of



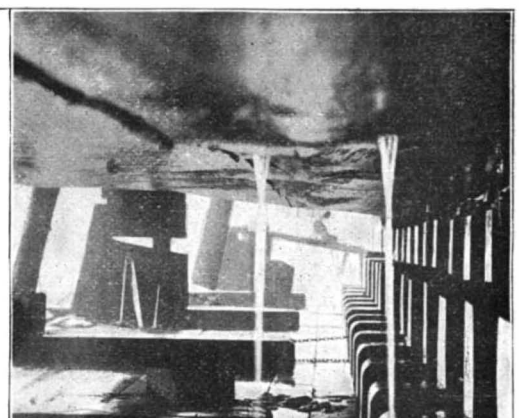
1.—Bow View of First-class Battleship "Massachusetts," Now Undergoing Repairs to Keel.



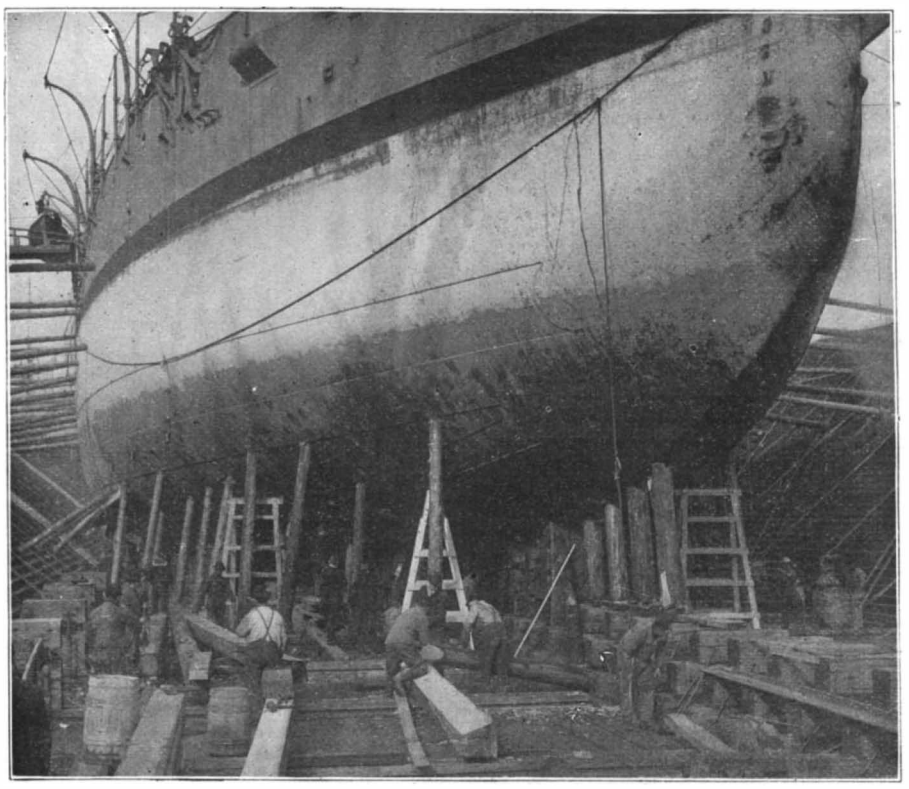
2.—Damaged Vertical Keel-plate Taken from Between Frames 14½ and 22½.



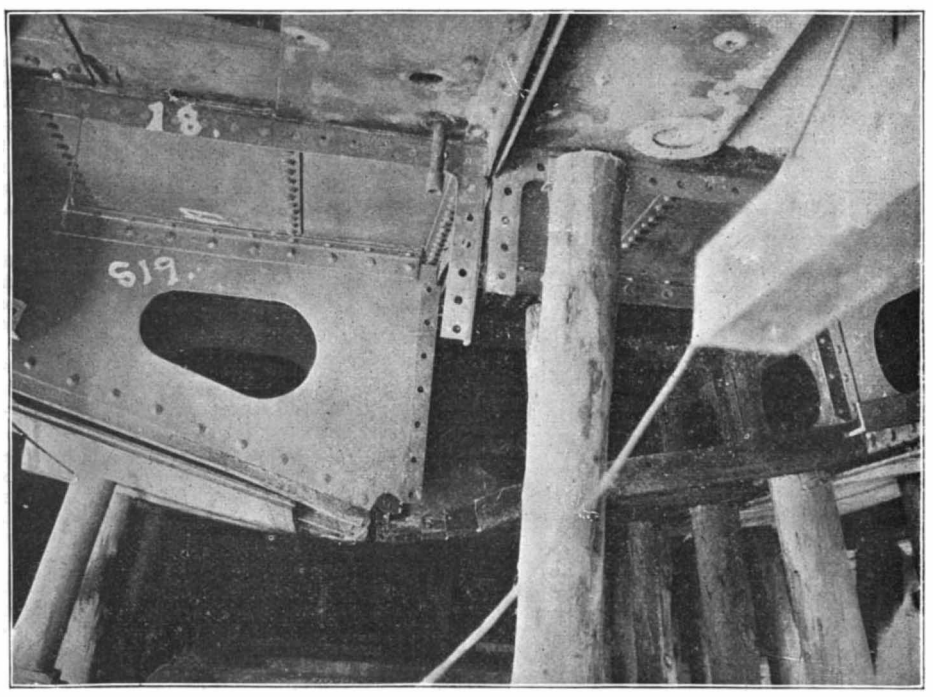
3.—Pneumatic Drills Drilling Out Rivets from Damaged Plating.



4.—Damaged Garboard Strake, Port Side, Looking Forward—Keel Block Seen at Right of Cut.



5.—Bow View of Ship when Water was First Pumped Out of Dock, Showing Method of Shoring.



6.—Showing Double-bottom Construction—Outside Plating and Section of Vertical Keel Removed.

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lines of shores which were placed beneath the two longitudinal girders which are within the double bottom, one on each side of the keel, and about 7 feet distant from it. These shores are shown clearly in Fig. 6.

The work of taking out the damaged plates, straightening them, and riveting them again in place, or, if they were too much damaged, replacing them by new plates, was done in sections; for it would not have been advisable to weaken the ship by disconnecting too much of the structure at one time. Our illustration, No. 3, shows the method of cutting out the rivets.

This was done by means of pneumatic drills, which drilled do in through the shank of the rivets sufficiently to allow them to be driven inward, clear of the plate, by means of a punch and sledge hammer. Half a dozen blows of the sledge were sufficient, usually, to drive out the rivet. When all the rivets had been removed, the plate would come away easily from the framing. Illustration, No. 4, shows the line of keel blocks on the right; some of the shoring pieces on the left; and above is the damaged garboard strake on the port side of the ship (the view being taken looking toward the bow of the vessel). The water is pouring from the double bottom through a couple of fractures in the plating, and the indented or corrugated appearance of the bottom is very clearly shown in this photograph. Perhaps the most interesting view is that shown in No. 6, which was taken looking aft along the center line of the keel after about 30 feet of the keel plate had been removed. This keel plate is shown in Fig. 2, and it will be noticed that the most serious distortion took place at frame No. 18. The view, Fig. 6, looking into the inner bottom, is quite unique, for it is very rarely that the camera has a chance to be set up in such a position as that from which the photograph was taken. The heavy shoring beneath the two longitudinals, which are 7 feet on either side of the keel plate, is seen clearly in this view.

These difficult repairs are proceeding very satisfactorily, and it is likely that before many weeks the "Massachusetts" will be afloat and in as sound condition as when she was launched.

The grounding of the "Massachusetts" will have served a good purpose if it leads to an immediate appropriation for removing the dangerous Diamond Shoal from the channel. As it now stands, this obstruction is a menace to every large warship that enters or leaves the Brooklyn navy yard.

A Double-Barrel Cannon.

In Athens, Ga., is a curious cannon which is now owned by the city and is placed on the City Hall lawn. It is probably the only double-barrel cannon of the kind in the world. It belonged to the "Mitchell Thunderbolts," a company of old men which was organized in Athens in 1863 for home defense. One of the company, John Gilleland, invented this cannon and had it cast at the Athens foundry. The idea was one of considerable ingenuity, but was entirely impractical. The ends of a 50 foot chain were attached to two cannon balls which formed the charge, and the idea of the inventor was that when the cannon balls came out of the muzzles of the cannon they would have a tendency to diverge, drawing the chain taut, and as they proceeded on their course would mow down a company. The cannon was taken out into the country, near Athens, one day to test it. It was properly charged and was fired with ceremony. Unfortunately, one of the cannon balls got out a little ahead of the other and the result was disastrous. Projectiles and chain had a kind of circular motion and plowed up about one-quarter of an acre of ground. The members of the Thunderbolt Company scattered in all directions to avoid being hit by the flying chain. The cannon was never used after that except at an occasional jubilee, when charges of powder was fired. A few years ago it disappeared, and finally it turned up in a junkshop, and was promptly purchased by the city. The owner of the cannon had been offered $50, but when he learned that the city wished the cannon, he promptly refused the offer and traded it with the State for an old bell.

Photography as an Aid to Exploration.

In a lecture delivered by Flinders Petrie, entitled "Photography the Handmaid of Exploration," he showed to what an enormous extent exploration has been aided by photography, and when we examine such books as Davis' "Carthage," we see to what extent explorations were handicapped in the days when photography was just coming into use. Especially in Egypt the success of photography is very great, owing to the splendid atmospheric conditions and fine sunlight which prevail in that country. Mr. Petrie finds that the great difficulty was in obtaining plates which were slow enough. With the aid of the camera not only can the actual finds be photographed, but the exact condition of the objects in situ can be recorded, furnishing valuable data. With the aid of the new surveying cameras the results will prove even more valuable. Some very valuable finds are of such a nature that they cannot be well removed, and in this case photography is also invaluable. Nowadays all explorers go equipped with the best photographic apparatus which money can purchase and an adequate supply of photographic materials.

The "Chicago" in Commission.

The "Chicago" left the Brooklyn navy yard on February 6, and will proceed to New Orleans to represent the Navy Department at the Mardi Gras festival on February 13. This is the first time the "Chicago" has had any sea service in four years. During the last two years she has been under reconstruction, and we have already illustrated the novel features of the remodeling. During the trip her guns and speed will be tested, and on returning from New Orleans she will join the North Atlantic squadron at Hampton Roads.

The Current Supplement.

The current SUPPLEMENT, No. 1207, has a number of articles of more than usual interest on account of the variety of the subjects treated. The largest and most complete yacht built last year in Great Britain, for Baron de Rothschild, is illustrated and described. "The Mutoscope" is illustrated by detail engravings showing how this very interesting American invention is worked. "Bridges over the Tiber in Ancient Rome" is an interesting illustrated article. "Women Inventors" will be warmly welcomed by many of our readers who have been inquiring for information on this subject. "Kieselguhr and Other Infusorial Earths" is an important paper. "In German New Guinea" is an illustrated article. "Low Temperatures," "Is the World Nearing Starvation?" and "Tuberculosis in Animals" are all interesting articles. "The Honey Bee" is a valuable article dealing in a popular way with the wonderful structure and performance of the bee.

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RECENTLY PATENTED INVENTIONS.

Bicycle Appliances.

PNEUMATIC TIRE.—ARRAH J. WHISLER, 180 Warren Avenue, Chicago, Ill. This tire has two layers of rubber with a layer of fabric between. The inner layer of rubber laps over for a considerable distance when the tire is put together and is fastened by cement and head-and-socket clasps. If a puncture occurs, the tire may be easily ripped open, and, after the puncture has been repaired from the inside, it can be fastened together again.

BICYCLE COUPLING.—FRANK BARTO, 150 Fifth Avenue, New York city. The object of this coupling is to allow of two bicycles being easily and quickly separated. Each cross connection is made by two metal inverted triangular yokes fastened together at their points by a flexible coupling. The upper base of the yokes pass through sockets that are clamped to the bicycle frame and have an up-and-down motion in them, thus allowing for inequalities in the road. Diagonal brace wires connect opposite sides of one of the cross connections with opposite sides of the other, and are tautened by a turnbuckle at their crossing place. Another cross connection with clamps on both forks of each wheel completes the coupling. To separate the bicycles, it is necessary only to unfasten the flexible couplings of the triangles and fold the latter back beside the frame of the wheels, and, at the same time, the brace wires may be loosened and unfastened.

BACK-PEDALING BRAKE.—CHRISTIAN H. SCHLAF, Springfield, Mass. This invention consists of a free running sprocket wheel driven by a smaller driving disk by means of dogs and lugs on the latter, which engage ratchet teeth in a ring on the surface of the sprocket. The driving disk has ratchet teeth on its periphery arranged so that when back pressure is applied a dog catches in one of these teeth and presses a band brake against a flange on the inner edge of the sprocket. When the forward pressure on the pedals is stopped, the driving dogs slip past the teeth in which they normally engage, thus allowing the machine to coast till a backward pressure is exerted. By means of the band brake on the sprocket, the wear and tear of a tire brake is avoided.

Household Inventions.

FOLDING TUB OR SIMILAR VESSEL.—J. A. SHEARER, Langley, Canada. The tub, pail, or similar article is made of canvas or rubber and has two stiff wire rings fastened in the material at top and bottom. The bottom ring projects somewhat beyond the bottom diameter of the vessel in order to allow wire brace rods, which are hooked around the top ring, to be sprung in place. These rods hold the vessel in shape while it is in use, after which it is easily folded for packing away.

CLOTHES RACK.—LOUIS A. WIECHEL and DAVID HIMMELHEBER, Evansville, Ind. This rack consists of a semicircular hanger projecting outward horizontally from a wooden support adapted to be hung on the wall. The hanger is made up of wedge-shaped radial center supports with spaces between to receive the ends of the arms. These are pivoted upon a semicircular pintle-rod, which passes through rectangular slots in the arms. The slots allow the arms to be advanced horizontally a little, thus withdrawing their ends from under a ledge and allowing them to assume a vertical position when not in use.

Miscellaneous.

WINDOW AWNING.—JOSEPH W. BUCK, Washington, D. C. The improvement in this awning consists in its being hung by cords passing through pulleys at the top of the window-frame. This arrangement allows of the awning, when dropped flat against the frame to act as a blind, being lowered from the top for ventilation. The cords which raise the lower end of the awning are rove through eyelets in it, so as to make even folds when the awning is raised.

CHANDELIER FOR PIANOS.—PETER ANDERSON, 456 College Avenue, New York city. The object of this invention is to attach a candlestick to the front panel of a piano or organ so that it will always be in a vertical position when the panel is inclined. The bracket holding the candlestick is pivoted horizontally to a flat bracket fastened to the panel and its end passes through this bracket and the panel. A rod extends downward from the end of the bracket and has a slight vertical motion in a suitable bearing. Another rod reaches upward from the fulcrum of the bracket and is similarly fastened in the piano top. When the panel is inclined, the rods allow the bracket to move upward slightly, at the same time retaining it in its original vertical position.

COMBINED WHIP-SOCKET AND REIN-HOLDER.—GEORGE W. HYDE, St. Paul, Neb. The feature of this device is its simplicity of construction. It consists of a pair of jaws for holding the reins, the inner one of which forms one side of a saddle-frame which fits over a support. The other side of the saddle-frame forms the inner side of the whip-socket, and the rest of the socket is formed from the same piece. Both holder and socket are formed from a single piece of spring sheet-metal. A simple clamp consisting of two beveled uprights bolted to the support on each side of the jaws and having a U-shaped cross-piece that fits around the outer jaw and presses against it, regulates the grip of the jaws by the cross-piece being fastened at different places on the beveled side-pieces.

COMBINATION AX AND CUTTER.—WILLIAM GARLICK, DAVID MURRAY, and ALFRED O. HOWSE, Wingham, New South Wales. This tool is designed for farmers who have to shoe their horses. It is an ordinary ax head, having two semicircular apertures in the case-hardened back edge, which act as cutters for cutting off horseshoe heads. In the center of the flat surface of the head is an aperture shaped so as to receive one end of a horseshoe. After the ax has been driven in a log, the horseshoe can be bent to the desired shape by placing the end in this aperture and hammering the shoe; or a portion may be cut from the heel of the shoe by hammering it on the cutters on top.

INCANDESCENT GAS LAMP.—ADALBERT KEYSSER, Hanover, Germany. The object of this invention is to protect the incandescent mantle from direct draught and also obtain a higher illuminating effect. This is accomplished by having an air chamber in the porcelain globe-holder. The air enters the chamber through small holes in the top, after passing downward between the chimney and surrounding globe. It becomes highly heated in this chamber, is drawn into the burner tube through the inlet apertures of the Bunsen burner, and is carried upward to the burner by the rising current of gas. A steady, intense light is thus obtained, while the tearing or bursting of the incandescent mantle, which results from direct impact of the air, is obviated.

ELECTRIC LAMP.—JOHN SLOANE MEAD, Mount Vernon, N. Y. This electric lamp consists of a containing tube in which several cells of a storage battery are placed end to end, the connection between cells being made by the contact of the bottom of one cell with the top of the next one. In one end of the tube is a small incandescent lamp set in a parabolic reflector behind a lens. A contact button of special design is suitably connected in the circuit so that by pressing it the lamp may be lighted at will. The containing case is uniform in shape and may be easily carried in the pocket.

PURSE OR BAG-FRAME.—JOHN KLEINSTUBER, 430 Broome St., New York city. This invention consists of a frame having pointed binding extensions by means of which the fabric is bound to the frame in a simple manner, thus avoiding the necessity of riveting the fabric to the covering channel-shaped frame bars. The fabric is first fastened to this frame, after which the frame is clamped in place in the covering frame bars of channel shape.

SEWING-AWL.—CHARLES A. NELSON, Gladstone, Mich. The stem of this awl consists of two parts, one fixed and the other movable upon it. An eye in the movable part of the stem is uncovered by working a catch on the handle of the awl. This enables the manipulator to slip in a thread easily after the point has been passed through leather, and, after closing the eye again, to draw the thread through the hole as the awl is withdrawn.

ICE CREEPER.—CHARLES G. BLANDFORD, Sing Sing, N. Y. This simple device consists of a wire in the shape of a double bow, two ends of which hook over the sole of the shoe at the instep, the other ends uniting in a loop which slips over the toe. At the points farthest apart on the two bows, and at the forward point where they cross, are spikes having cruciform bases through which the wires pass. A sinuous wire connects the two opposite points, and its ends hook over the sole.

ROTARY TOOTH-BRUSH.—ADRIAN MARIE WILLEM TER LAAG, Philipsburg, St. Martin, West Indies (via St. Kitts). This rotary-brush is fastened to the end of a shaft which revolves in a casing and is turned by a handle moving on a thread at its further end. Half of the brush is covered by a shield so as to protect the mouth when brushing the back of the teeth. The brush is easily removed from the shaft and replaced with a new one. There are several designs of rotary-brushes to choose from. The advantages of this form of brush are that it brushes in the direction of the bars of enamel and between the teeth in an efficient manner.

PERCOLATOR-PACKAGE.—HENRY M. HUMPHREY, Plainfield, N. J. In the present invention a package is provided for coffee and tea-pots, which is designed to contain the tea or coffee to be infused or boiled. The package is made of a porous fabric, such as muslin or cheese-cloth, and is provided with a weight whereby it is held in position. The weight assists the package in its downward course and serves constantly to change the position of the package so that the hot water will have free contact with all the surface. The weight is, moreover, so constructed that it may be employed to direct the coffee-containing package from a coin-operated machine. It is evident that the package can be made of such size as to contain coffee or tea enough for one cup or for two or more cups. After the coffee or tea has been thoroughly exhausted, the bag can be removed and the pot left entirely free from all grounds.

Designs.

CUT GLASS VESSEL.—T. B. CLARK, Honesville, Pa. The design is a bowl-shaped vessel with scalloped edges, the surface of the bowl being divided into four triangular-shaped pentagons circumscribed around a quadrilateral space in which is a diamond-shaped rosette. The main feature of the design consists in a lapidary figure faceted in imitation of a diamond, which is inscribed within a circle in each of the five pentagons. The pentagons are separated by radial fields made up of rosettes bounded by ornamental radiating bands.

BUTTON-HOLDER.—ADOLPH SAMETZ, 212 Wooster St., New York city. A rectangular card having T-shaped openings with eyelets at each end of the horizontal slit. The corners at the juncture of the two slits are curved outward.

BACK-BAND HOOK.—HUGH P. QUIN, Washington, Ga. The upper half of this hook is broad, and contains a shield-shaped opening with a small hole near each point of the shield. The lower half tapers inward and contains a U-shaped opening, from the bottom of which a hook rises and curves inward, terminating in the center of the opening.

POCKET FOR GREASE-CANS.—ALDEN CROCHERON, Salt Lake City, Utah. This pocket is designed to be fastened to the exterior of a grease-can for the purpose of holding a swab. Attached to one side of the interior is a curved, flat, steel spring, which clamps the brush when inserted. The bottom of the pocket is inclined inward and downward toward the surface of the can. It makes a very complete and convenient device for the purpose mentioned.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

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NEW BOOKS, ETC.

ANIMATED PICTURES. By C. Francis Jenkins. Washington. 1898. Pp. 118. Price $2.50.

The volume before us deals with the development of moving photography and is written by an inventor of a successful machine. His advice on the technical aspect of the subject is very valuable, and there is no doubt it will be interesting to many photographers. Formulas for developing negatives and positive films, etc., will prove of great value. The book is well illustrated.

THE BUTTERFLY BOOK. A Popular Guide to a Knowledge of the Butterflies of North America. By W. J Holland. New York: Doubleday & McClure Company. 1898. Pp. 382. Price $3.

The time has arrived when thoroughly scientific books, especially books on natural history, with proper plates and illustrations, can be sold at a price which puts them within the reach of even the scientific student, whose purse is proverbially small. The volume before us is not only a work for the student of natural history, but for the library as well, and any publisher who will issue a beautiful book of this kind deserves the hearty commendation and support of the entire scientific press. The splendid quarto is illustrated with forty-eight beautifully executed plates in color photography and hundreds of illustrations. It is printed in clear type on handsome paper with generous margins and has the handsome green top which is infinitely more artistic than the gilt top. Dr. Holland's book deals also with the capture, preparation, and preservation of insects and gives information which is perfectly invaluable to the beginner. Of the scientific aspect of the book we can only say that the reputation of the Chancellor of the Western University of Pennsylvania rests on too sure a foundation to need any bolstering up. Dr. Holland is emphatically the American authority on butterflies, and has written this book with the aim of popularizing their study. It should be noted that the plates are photographed directly from the butterflies themselves, and present to a degree the exact tones and shades of the originals. They represent the highest mark yet reached in color photography.

OUR NAVY IN THE WAR WITH SPAIN. By John R. Spears. New York: Charles Scribner's Sons. 1898. Pp. 406. Over 100 illustrations. Price $2.

This very timely and interesting work really forms the fifth volume of the author's well known "History of Our Navy," with which it agrees in general style of text and illustrations. The latter, however, are superior to those of the earlier volumes, presenting more technical detail and possessing a corresponding value. The story of the war, which is written in the author's well known and characteristic style, commences, as it properly should, with some account of the causes which led up to the recent hostilities. The first two chapters deal with the ten years' insurrection, the third and fourth describe the birth and growth of the new navy, and the fifth is devoted to the causes which led to the sending of the "Maine" on her fatal mission to Havana. After two chapters devoted to the preparations for war and the war message, the story of the actual struggle commences, and the interest is easily sustained throughout the 250 pages that follow. The author gives a strong flavor of the sea to his story of the war, and its stirring events are brought before the eye with vivid distinctness. The last chapter, on our new naval programme, is particularly valuable, for the reason that here, as elsewhere, the author does not fear to indulge in that free criticism of the weak points of our navy without which any adequate progress is impossible. The subjects for illustration are well chosen and include the ships, the heroes of the war, and various scenes of the struggle both on sea and land. We note that in the last chapter many of the illustrations are reproduced from the pages of the SCIENTIFIC AMERICAN.

THE PRACTICAL COMPOUNDING OF OILS, TALLOW, AND GREASE FOR LUBRICATION, ETC. By an Expert Oil Refiner. London: Scott, Greenwood & Company. New York: D. Van Nostrand Company. 1898. Pp. 96. Price $3.50.

A practical work by a practical man is always of standard value. The volume before us treats comprehensively the subject of hydrocarbon oils, animal and fish oils, compound oils, vegetable oils, lamp oils, machinery greases, etc. It is filled with valuable receipts and tables.

THE SPEED LATHE. By A. G. Compton and James A. De Groodt. New York: John Wiley & Sons. 1898. 12mo. Pp. 134. 99 illustrations. Price $1.50.

The book before us is the first of a series of three on advanced metal work, giving lessons on the speed lathe, engine lathe, and planing machine, for the use of technical schools, manual-training schools, and amateurs. If the other volumes of the series compare in any way with the present one, we can only say that they will make one of the most important contributions ever made to the now extensive literature of manual training. We have often wondered why an adequate work on the speed lathe was not written, as these lathes are in use in every school in the United States where manual training is taught. The illustrations are most admirable, and they are so clear that even the amateur, without previous instruction, can learn to do splendid work with their aid. In addition to wood turning and pattern making, brass turning, metal spinning, and burnishing are also included. The book is a most admirable one, and is worthy of a very large sale.

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We have just printed a new edition of De Brevans' "Manufacture of Liquors and Preserves." This will doubtless be welcomed by some of our readers, as the former edition was entirely exhausted and some of our customers were only able to obtain copies at a considerable advance on the published price. We are now able to supply copies as wanted.

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Patent for sale entire, or wanted manufactured on royalty, the bottle shown on page 100, this issue. Address as in notice.

For Sale—U. S. patent on Tellurian described in this paper February 11, 1899. Charles J. Boehm, 409 Seventh St., Milwaukee, Wis.

Grease Can patent noticed on page 108 of this issue for sale. Address inventor, Alden Crocheron, 206 N. 2d West St., Salt Lake City, Utah.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7594) F. S. G. asks: How many feet of No. 18 bare iron wire (B. & S. gage) will it take to make a core 11 inches long and 1 inch in diameter? Core to be used in an induction coil. A. There are several ways of solving this problem, which we give to show others as well as you how to help themselves. 1. Find the weight of a bar of iron of the size of the core, from the specific gravity of iron, 7·75 about. This will give a weight of wire somewhat greater than is needed, but iron wire is cheap. 2. Find the area of the end of the core, a circle 1 inch in diameter, and divide this by the area of cross section of the wire, taken from a wire table. This will give the number of pieces approximately. An error will be due to the fact that no allowance is made for the spaces between the wires. 3. Find the number of wires which, laid side by side, will fill one inch. Multiply this number by itself, and you will have the number which will go into a square inch. Multiply this by the area of a circle 1 inch in diameter, and the product is the number of pieces of wire which are required for the core. This multiplied by 11 will give the length required in inches. No. 18 wire B. & S. is 0·04 inch in diameter, therefore 25 pieces laid side by side will occupy one inch, and 625 pieces will fill one square inch. A circle 1 inch in diameter contains 0·7854 square inch exactly. Multiply 625 by this, and you find 491 pieces 11 inches long are required. It would be exact enough had we said a circle 1 inch in diameter is about ¾ of a square inch, and ¾ of 625 is about 475. You will probably not get more than 475 pieces into the space, since you will not be able to straighten them perfectly or to bind perfectly solid.

(7595) W. W. D. writes: I recently magnetized an ordinary black steel pin (the head having been removed) by rubbing it on a lodestone. I am greatly puzzled by the behavior of a compass needle when the magnetized pin is brought near to it. The north pole of the compass needle is repelled by each end of the pin indifferently and the south pole of the needle is attracted by each end of the pin. Further, the middle of the pin strongly attracts the north pole of the needle and repels the south pole. This upsets all my notions of magnetism. Can you give me any light on the subject? A. You have evidently made a magnet with south pole in the middle and north poles at each end. To do this you must have rubbed both ends of the pin on the same pole of the lodestone. This is not a new thing, though such a magnet seems very curious. Such a magnet can be made by winding one-half of the length of a bar with wire in one direction, and bending the wire back, wind the other half of the bar in the opposite direction. Now send the electric current through the wire.

(7596) G. W. F. asks: 1 What kind of steel is used in the manufacture of permanent magnets? A. The best tool steel should be used. 2. To what extent hardened or tempered? A. Hardened glass hard at the ends, by heating end red hot and plunging into water. 3. What is the best method of magnetizing them? A. Magnetize the bar by a coil of wire through which a strong current of electricity is flowing. See answer to query No. 7185.

(7597) J. D.—Write again, giving your full name and address.

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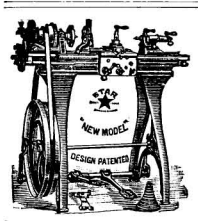

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9 and 11-inch Swing.
New and Original Features
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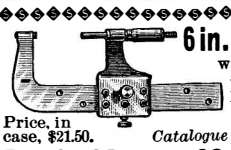

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FOR LIGHT WORK.
Has these Great Advantages:
The speed can be instantly changed from 0 to 1600 without stopping or shifting belts. Power applied can be graduated to drive, with equal safety, the smallest or largest drills within its range—a wonderful economy in time and great saving in drill breakage. Send for catalogue.
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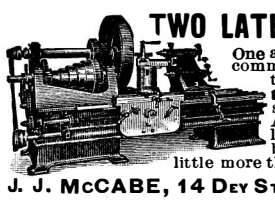
... HOLYOKE, MASS ...

McCabe's Pat. Double Spindle Lathe
TWO LATHES IN ONE.



One a 26-inch swing for the common run of work, and the other a powerfully **triple-geared** 44-in. swing for heavy work. A substantial, carefully designed and well built tool. Costs but little more than an ordinary lathe.
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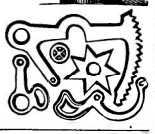

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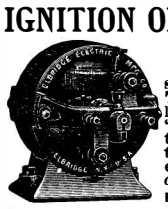

solved by the use of our New Type "S" Dynamo. Weight 47 lbs., speed 1400, height 10 in. Type "S" is for a small generator to take the place of Primary or Storage Batteries for igniting gas or gasoline engines. *Send 2c. stamp for illus. catalogue.* Elbridge Electrical Apparatus Co., Elbridge, N. Y., U. S. A.

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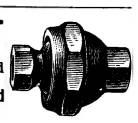
for Steam, Air or Liquids.



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Rein guide, G. W. Morris	619,205
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Rivet setting machine, E. A. Barber	619,247
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Rock drills, die for manufacturing or sharpening star bit, H. O. Palmer	619,087
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Rotary internal combustion engine, J. W. & P. L. Tygard	619,004
Rule gage, proportional slide, A. D. Linn	618,888
Ruling machine, F. H. Van Loozen	619,241
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Sash operator, H. B. Sargent	618,961
Saw, hand, W. A. Kindt	619,079
Sawmill head blocks, wing for knees on, B. Brink	619,130
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Scale, flour or grain, J. Doriot	618,983
Scissors or shears, Hobbs & Sperry	618,879
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Seal lock, A. W. Coffin	619,140
Seal lock, W. H. Goehrs	618,936
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Sewing machine, Dial & Dimond	619,250
Sewing machine attachment, Cain & Sangtinette	619,070
Sewing machine trimmer, C. Baumann	618,977
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Shoe tree or jack, C. Bleam	619,127
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Shuttle, O. W. Schaum	619,232
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Sign, W. E. Page	618,949
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Smoke consumer and back pressure reducer, J. Y. Smith	619,051
Smoothing or pressing box iron, M. Elb	618,933
Snap hook, C. E. Smith	618,912
Spectacle temple attachment, L. F. C. Giebericb.	619,163
Spindle. See Cap spindle.	
Spindle, J. Battersby	619,008
Spraying device, W. A. Judd	619,257
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Sprinkler. See Fire sprinkler.	
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Stacker, pneumatic straw, F. M. & W. R. Nash	618,898
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Steam generator, J. H. Fournier	619,160
Steam trap, A. Musnicki	619,207
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Towing machine, vessel, M. L. Deering	619,073
Trace holder, G. A. Hess	619,176
Trap. See Animal trap. Hog trap. Steam trap.	
Trap net, A. S. Chase	619,138
Trimmer. See Sewing machine trimmer.	
Trolley catcher, C. H. Ocumpaugh	619,213
Trolley connection for canal boats, F. J. Shewring	618,911
Trolley pole, P. H. Gilbert	619,164
Trolley pole and wheel, F. Kramer	619,080
Trunk strap, H. D. Wiard	619,243
Truss, E. A. Kellogg	619,185
Tubes, manufacture of, R. C. Stiefel	618,917
Tubes or other receptacles with rubber solution, etc., machine for filling, W. C. Brett	619,067
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Typewriter ribbon feed mechanism, C. Spiro	619,027
Typewriting machine, W. P. Quimby	619,260
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Valve, cutoff, C. A. Peterson	619,088
Valve, pressure relief, G. T. Prince	618,903
Valve, steam engine reversing, S. M. Coffman	618,839
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Velocipede, water, A. Rasmussen	619,224
Vent, automatic air, G. F. Smith	618,913
Vessels, construction of, J. M. Fehrenbach	619,155
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Washing machine, H. Hubbard	619,178
Water heater, W. A. Tichenor	619,101
Water wheel, W. A. Doble	619,148, 619,149
Water wheel, current, J. P. Whidden	619,005
Waterer, automatic stock, E. A. Losee	619,081
Wheel. See Variable diameter wheel. Water wheel.	
Wheel rim, J. Craig	619,141
Wheel rim for cycles or other vehicles, C. W. Atkinson	619,246
Wheels, pulleys, etc., apparatus for manufacturing, W. Malam	619,197
Whiffletree hook, W. E. Morgan	618,960
Window screen, T. E. Barr	618,828 to 618,831
Window screen, E. E. Mallory	619,198
Window screen and controlling apparatus, T. E. Barr	618,822
Window screen, roller, T. E. Barr	618,823, 618,826, 618,827
Wire rod mill, P. L. Day	619,036, 619,144
Wood scraper, C. L. Britt	619,131
Wrench, J. Gardiner	618,859
Wrench, M. Lemley	619,193
Wrench, W. M. Norcross	618,899

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Booklet, souvenir, P. Hake	30,132
Bottle, M. J. Olsen	30,134
Box blank, W. M. Wellman	30,160
Box lid, R. M. Hollingshead	30,161
Chair back, Goblke & Irwin	30,138
Clothes line props, body member for, M. M. Lightfoot	30,137
Dress edging, A. Vogt	30,165
Fabric, H. L. Andrews	30,166
Fork and spoon, combined, Whitcomb & Barnard	30,129
Game counter, E. L. Williams	30,158
Headlight, locomotive, J. N. Barr	30,146
Heater, J. S. MacKenzie	30,143
Heel plate, W. Kratz	30,162 to 30,164
Lamp, bicycle, E. L. Williams	30,150
Lamp fixture, J. F. Williams	30,147 to 30,149
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(Continued on page 111)

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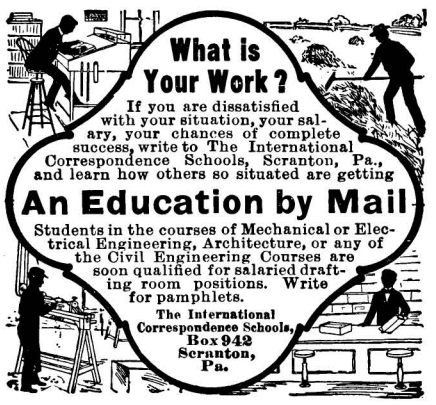
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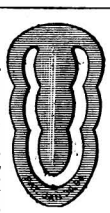

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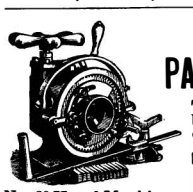
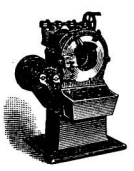


Two and three inch pipe can be threaded by a boy using only one hand on a crank.
☞ *Send for illustrated catalogue*
CURTIS & CURTIS,
No. 30 Hand Machine. Range ¼ to 2" R. & L. 6 Garden St., Bridgeport, Conn.

The Perfection of Pipe Threading



is admitted to be reached when our
No. 9½ PIPE THREADING MACHINE
is used. As a hand machine it is the only one known that will cut and thread an 8 inch pipe with ease and satisfaction. One valuable feature is, that it has no arbitrary lead screw for determining style or pitch of thread to be cut. ☞ *Send for Catalogue.*
THE MERRELL MFG. CO.
501 Curtiss St., Toledo, Ohio.

The Yankee DRILL GRINDER

for grinding both Twist and Flat Drills. Grinds all sized drills from ⅛ to 2½ in. Can be set for any size in a few seconds. Gives any desired clearance. Fully guaranteed.
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ROYAL MANUFACTURING CO. Box 713, DETROIT, MICH.

PROPOSALS.

Commission
NEW EAST RIVER BRIDGE,
City of New York.

Notice to Contractors.

FEBRUARY 3, 1899.

Proposals will be received by the Commissioners of the New East River Bridge, at their Office at No. 49 Chambers Street, in the Borough of Manhattan, in the City of New York, at two o'clock in the afternoon of the 18th day of February, 1899, endorsed "Proposals for Construction of Steel Towers and End Spans of the New East River Bridge," for furnishing the materials for and constructing the Steel Towers and End Spans of the New East River Bridge, in accordance with the proposed form of contract and the drawings and specifications therefor. All bids shall be inclosed in sealed envelopes, addressed to Lewis Nixon, President of the Board of Commissioners of the New East River Bridge, and presented to him on that day and at that hour at said office, and such bids will be opened in public meeting by the said Commissioners on that day at two o'clock in the afternoon.

Copies of the specifications and the general drawings for the work, with the proposed forms for the bid, bond and contract may be seen, and further information will be given at the office of the Chief Engineer, No. 84 Broadway, Borough of Brooklyn, City of New York, on and after the 6th day of February, 1899.

Particular attention is called to the following changes which have been made in the specifications and drawings issued in February, 1898:

The first sentence in Section 28 of the specifications shall read thus: "28. All steel shall be acid open hearth, made by the pig and ore process from stock satisfactory to the Engineer."

The following section shall be inserted after Section 103 of the specifications: "Rust Joints. 103a. All foot castings shall be bedded on rust joints satisfactory to the Engineer."

Drawings Nos. 148 and 149, dated January 10, 1899, replace drawings Nos. 148 and 149, dated January 10, 1898; and drawing No. 163, dated December 29, 1898, is added to the drawings.

The Commissioners require that all bidders shall carefully examine the specifications, drawings and proposed form of contract, in order that no question as to their meaning may arise hereafter. It must be distinctly understood that no changes in the quality of the materials or of the workmanship will be allowed, and that the specifications will be adhered to strictly.

The contract is to be completely performed on or before the twenty-eighth day of February, 1900.

Proposals will be made upon a form provided therefor, and only those proposals will be considered which are complete, in proper form, comply with the requirements herein stated, and are offered by parties of known reputation, experience and responsibility.

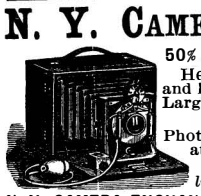
Each bidder will be required to deposit, with his proposal, in the office of the Commissioners, a certified check for $10,000, payable to the order of Julian D. Fairchild, as Treasurer of the New East River Bridge Commissioners, as security for the execution by him of the contract and the giving of the required bond, if his bid is accepted, within two weeks after notice of the acceptance of his bid.

The Contractor will be required to give a bond in the penal sum of $400,000, in the form annexed to the proposed form of contract, with an approved surety company doing business in the City of New York, conditioned for the prompt and faithful performance of the contract and its covenants and the work thereunder.

As by far the greater part of this work can be executed only by bridge establishments of the first class, bids will be received only from such parties as have the requisite plant and facilities, which have been in successful operation on work of similar character for at least one year. The bidders must be, in the opinion of the Commissioners, fully qualified both by experience and in appliances to execute work of this character and importance according to the highest standard of bridge work at the present time.

The Commissioners reserve the right to reject any and all of the proposals offered, and to accept any proposal offered. LEWIS NIXON, *President.*
SMITH E. LANE, *Secretary.*

N. Y. CAMERA EXCHANGE.



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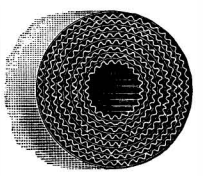

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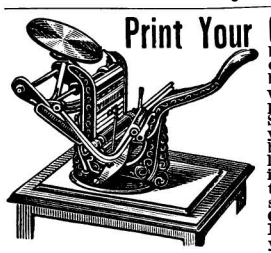

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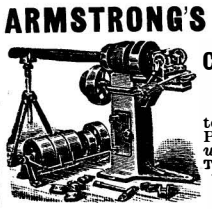

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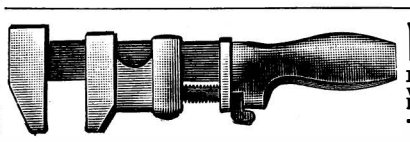

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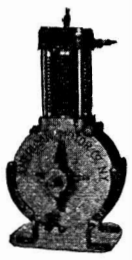

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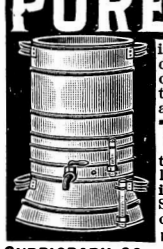

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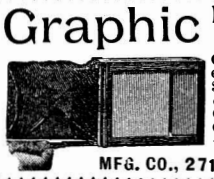

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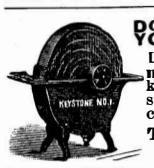

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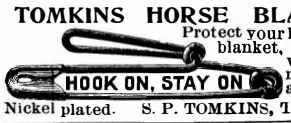

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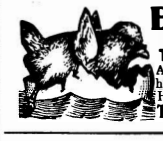

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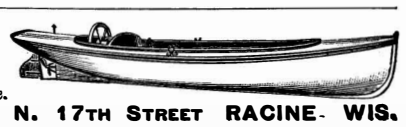

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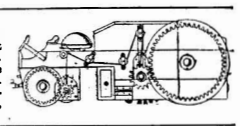

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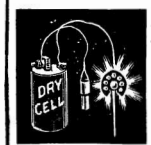

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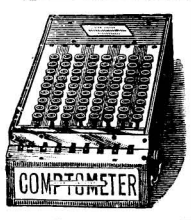

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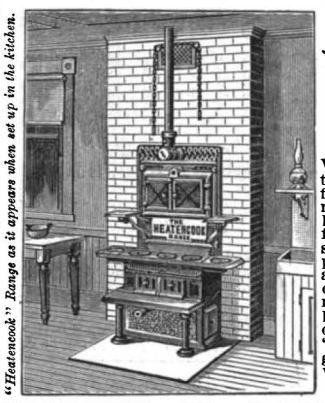

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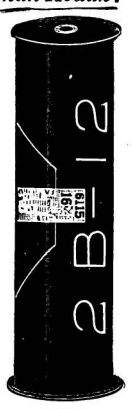

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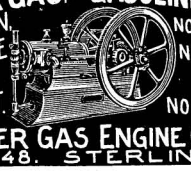

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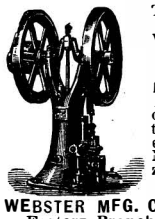

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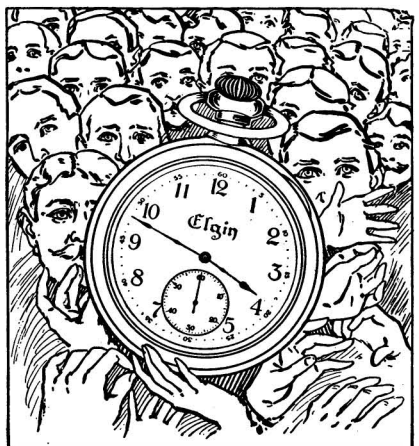

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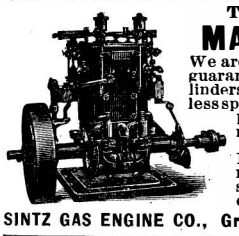

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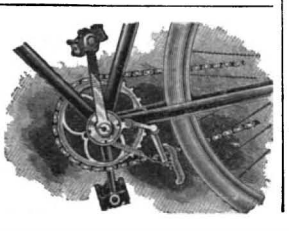

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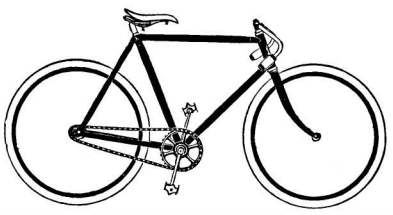

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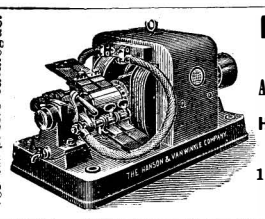

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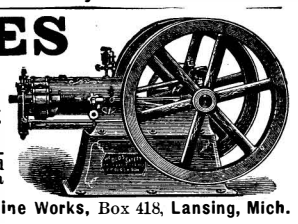

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